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PUBLIC WORKS Magazine

Devoted to the interests of the engineers and technical officials of cities, counties and states

Vol. 78, No. 5

W. A. HARDENBERGH and A. PRESCOTT FOLWELL Editors

MAY, 1947, CONTENTS

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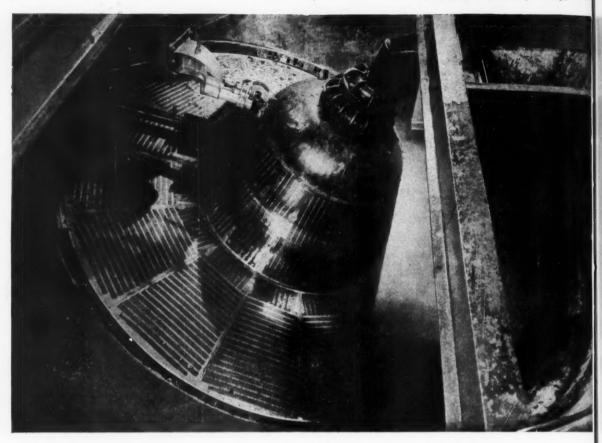
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The Editor's Page

The Responsibility of Leadership

The willingness of so many engineers to devote their lives to public service is a thing that the whole profession is proud of. There are many outstanding men who are willing to serve with little in the way of

recognition.

But there is another side to this problem. These men, imbued with the idea of service, are often satisfied to exist on a shamefully low rate of pay. Too often they do not realize, in their zeal for public service and lack of interest in fair compensation, that they are unfair and unjust to the men under them; and eventually to the community they serve. If the head of a division is willing to work at, say \$300 per month, what can his staff look forward to! The future is surely not a bright one for them. Only the second-rate men will remain indefinitely under such conditions.

Engineers do not always realize that they are as responsible for the welfare of the men under them as they are for sound engineering design and judgment. It is a phase of engineering that too often has been overlooked, and to an unfortunate degree. Engineers must realize their responsibility in this regard and must make adequate provision for the advancement and compensation of the men under them, irrespective of their own willingness to be good public servants and to be paid mainly in public appreciation and

esteem.

Contractors on Highway Work—And New Ideas

The Federal Works Agency reports that during the past six years, a total of 3,057 contractors performed Federal-aid highway construction. During the depression years of 1935 to 1940 there were considerably more contractors, 5,614, in fact. This reduction in the number of highway contractors is believed to be due to the fact that during the depression period many small contractors entered the highway field, and these have since returned to their former lines of work. During 1946, about 350 contractors who had not previously performed such highway work were added.

We have previously pointed out that the past few years have witnessed the greatest turnover of engineering and construction personnel in history. It is time to think in new terms, whether these be of engineering personnel, lists of contractors, or methods of doing work; 1940 is a long way back in point of time and

still further as regards actual conditions.

Municipalities Should Order Equipment

A good deal of needed work is being held up because of delay in the procurement of equipment. With a delivery date of 6 weeks on one item, 15 weeks on another, and perhaps 6 months on a third, awards of contracts cannot be made, for few contractors will make a firm price to-day on work to be done 6 months

For needed work, the village or city should order equipment and materials, giving the manufacturers time to fabricate and deliver these. When the material

has been assembled, the contract can be awarded with assurance as to prices and date of completion of work.

This plan is a sound one, and one that will permit necessary work to be carried out just as quickly as equipment can be made. It presupposes and requires good engineering, by capable consulting engineers who are interested in a good job, and who are not of the build-and-begone type.

Water Works and Emergencies

It no doubt gave a good many of our readers, as it did your editor, a thrill of pleasure to read that "water service is now back to normal" in Texas City. Water service was restored while the smoke was still rolling up. This is a tribute to the spirit of our water department personnel, to the good materials and design incorporated in our plants, and to the sound training program that has been carried on. We congratulate our Texas folks; they do things in a big way, whether it is in having a catastrophe, or in pulling out of it.

Sanitary Engineering in the Army-HR 1982 and HR 3215

A new bill has been introduced into Congress, in substitution for HR 1982. This new bill is HR 3215, and it is just as unsound, unfair and vicious as its predecessor. It contains essentially the same provisions; it places engineers and other scientists on a definitely inferior status; it submerges them in the same helter of miscellaneous non-technical personnel; and it restricts promotion in the same way.

Everyone interested in the future of engineers in the army, in a sound post-war organization for national defense, and in a fair deal for all should write their respective Congressmen and Senators at once, and restate emphatically their opposition to HR 3215. Everything that applied to HR 1982 applies equally

to HR 3215.

Write to your Congressmen and Senators to-day.

To All Sanitary Corps Officers

Please communicate with Colonel M. J. Blew, giving rank; when called to active duty; present rank or rank on separation; specialty (engineering; entomology, parasitology, bacteriology, chemistry, nutrition, etc.); a resumé of pertinent facts regarding active duty assignments; academic and professional degrees; professional and honorary Society affiliations; whether registered or certified, etc., and any comments or suggestions you desire to make.

This information is desired to complete an accurate post-war roster and also in preparing an analysis and evaluation of the activities and contributions of the Corps during the war. Existing information is inaccurate and incomplete and the cooperation of all officers and former officers is desired so that a correct picture of their accomplishments can be prepared.

Send reply to: M. J. BLEW, c/o National Society of Professional Engineers, 1359 Connecticut Avenue,

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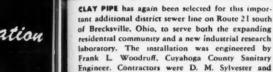
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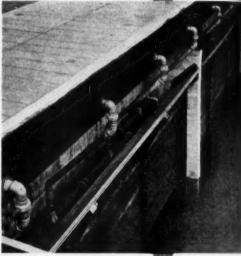
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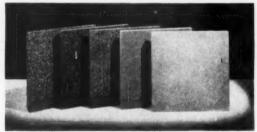
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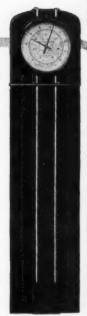
Precise controls and complete instrumentation are as necessary to a modern water works as to airlines — guarding a community's health and protecting lives. For safe, efficient operation every water works plant must be adequately equipped with instruments. Builders Gauges tell the complete story of plant operation. They indicate and record loss of head, rate of flow, water level, sand expansion, etc., and are styled to harmonize attractively with the architectural design of the modern plant. For Bulletin 329A, address Builders-Providence, Inc., (Division of Builders Iron Foundry), 16 Codding St., Providence 1, R. I.



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Economic Flocculation of Sewage Colloids

After sedimentation, one-third to one-sixth of the sewage flow is treated by the activated sludge process and then remixed with the remainder of the sewage.

Based on their experiences and experiments and those of others, two English engineers, John Finch and L. S. Wright, have developed a modification of the activated sludge process combined with bioflocculation and filtration. They described this process in a paper before the February meeting of the Northeastern Branch of the Institute of Sewage Purification, from which the following is condensed.

Quoting O'Shaughnessy, they say: "Settled sewage contains non-settling colloidal matter, which may choke the trickling filter, but which may be flocculated very rapidly by the activated sludge process. It also contains material which may be dealt with only slowly by the activated sludge process, but which is dealt with easily, rapidly and therefore economically by the filter."

Experimenting with various mixtures of primary tank effluent and activated sludge, they found that: "The initial removal of oxygen absorbed is very rapid. The final rate of removal is much slower.

"The clarification or floculation stage is confined principally to the first hour or two of aeration. It is chiefly physical in nature and produces the bulk of the improvement in the sewage affected by the process. There are two requisites, namely, an activated sludge added to the sewage and circulation of this sludge through the sewage. It is thought that oxygen is not so essential at this stage."

Average results of a series of tests are shown in the accompanying table, which "seems to indicate that 3 to 8% sludge will produce the desired removal of colloids." "From the work carried out the following facts seem to become prominent: (i) The early part of the purification-time curve is very steep, *i.e.*, initial puri-

Primary Settling Tanks	To sludge disposal plant
Bio-Flocculator	
Intermediate Settling Tanks	To studge disposal plant
1	
	Bio-Flocculator Intermediate Settling

Suggested layout of plant.

fication is very rapid. (ii) During the first hour there is a considerable reduction in turbidity, i.e., colloids are removed rapidly. (iii) By the addition of between 3 and 8% activated sludge it is possible to remove by flocculation about 33% of the load in thirty minutes. (iv) It would appear that for unit time increased reduction of load is proportional to the increased concentration of sludge in the mixture. (v) When sludge is added as a weak suspension in a purified liquor (as from aeration unit), the degree of purification would seem to be higher than would have been the case had the same amount of sludge been concentrated. This was confirmed by later experiments. (vi) So far as activated sludge is concerned as a means of flocculation, it is extremely doubtful whether re-aeration or re-activation of the sludge, after flocculation, is economically worth while.

"From the foregoing results it would appear that an *economic* bioflocculation plant would have the following characteristics:

"(a) A capacity of about half an hour.

"(b) Use sludge concentrations of the order of 3 to 7%.

%	0	xygen a	absorbe	% pt	on.		
sludge.	Tank con- tents.	After 15 min.	After 30 min.	After 60 min.	After 15 min.	After 30 min.	After 60 min.
2	7.98	6.80	6.02	5.55	14.8	.24:9	30.5
3	7.07	5.08	5.06	4.49	28 · 1	28.2	36.4
4	6.57	4.79	4:51	4.20	24 · 1	31.4	36.1
5	6.78	4.95	4.32	4.12	26.0	36.2	39 - 2
6	6.34	4.66	3.71	3.77	26.9	41.5	
7	6.22	4.42	3.99	3.55	32.2	35.8	43.0
8	6.54	4.62	4.01	3.30	29 - 1	38.7	49.6
10	6.23	4.13	3.72	3.30	33.6	40.4	47-1
12	6-07	3.89	3.40	3.31	35.8	43.9	45.4
14	6.99	4.95	4.34	3.70	29.2	38.0	47 - 2

Effect of various concentrations of sludge.

"(c) Be supplied with fresh well-aerated activated

sludge.

"Sufficient activated sludge can be produced in a complete treatment plant dealing with one unit of sewage, to supply a bioflocculation plant dealing with

about three units of sewage.

"The process to be put forward in this paper consists of giving crude sewage the normal preliminary treatment, i.e., the removal of grit and primary sedimentation, passing approximately one-third to onesixth of the flow of primary settling tank effluent to a complete treatment activated sludge plant, in which sufficient well-aerated activated sludge will be produced to remove all the colloids in the rest of the primary settling tank effluent in the bioflocculation plant. This will be achieved by passing the whole of the activated sludge and effluent as they are produced into the bioflocculation plant along with the main body of the primary effluent. In the bioflocculation plant the mixture will be left a sufficient length of time (approximately half an hour) to enable colloids to be removed. The activated sludge having so quickly removed the colloidal matter, no attempt is made to render the precipitated colloids stable and well oxidized, but the spent mixture of activated sludge and precipitated colloids are settled from the treated primary effluent and pumped to the appropriate sludge disposal process.

"In the system described the activated sludge plant proper is only intended to produce the flocculating agent or material-sludge. This it can produce in the

required quantities.

"In operation, the plant will be almost automatic, sludge being produced in direct proportion to the amount of colloidal matter, i.e., in times of rain little sludge would be produced or required. In times of dry weather, larger amounts of sludge would be produced and used in treating the strong sewage. During flows of weak sewage no activated sludge would be withdrawn from the 'producer' plant, thus building up supplies to be used on more appropriate occasions.

Partial treatment plants usually have low flocculation periods (one-half to two hours), but unfortunately have high re-aeration periods. The suggested modification takes advantage of the high initial efficiency of well-aerated activated sludge (prepared in a subsidiary complete treatment plant) in rapidly removing the colloidal and suspended matter from the settled sewage. The spent activated sludge is then pumped to waste, it being considered economically unsound policy to spend considerable time in reaerating. The process lends itself to adjustment in detail and is elastic to a great degree."

Contracts for Engineering Services Do Not Require Calling for Bids

DECISION was recently handed down by the A Supreme Court of the State of California in the case of Clyde C. Kennedy vs. the City and County of San Francisco, which affirmed the validity of a contract for consulting engineering services without taking competitive bids. A portion of the decision, with refer-

ences, follows:

It is true that the mode prescribed for the exercise of power by a public officer is the measure of the power. (Kottman vs. San Francisco, 20 Cal. 97,103; Los Angeles Dredging Co. vs. Long Beach, 210 Cal. 348, 353.) It is also true that the framers of the charter were at pains to require that contrtacts for the construction of public works should be subject to competitive bidding, and it is assumed that all contracts for the construction of the improvement will conform to that procedure. But it does not follow that strict compliance with that requirement must be maintained in procuring expert services to furnish plans and specifications for construction. In Los Angeles Dredging Co. vs. Long Beach, supra (210 Cal. at p. 354), it was recognized that there are exceptions to the requirement that contracts must be let under competitive bidding, the court saying: "The first exception is founded on the fact that sometimes it is undesirable or impossible to advertise for bids for particular work. In such cases the statutory requirement is deemed not to apply. In 2 Dillon Municipal Corporations 1199, section 802, the law is thus stated: 'It has been held that where competitive proposals work an incongruity and are unavailing as affecting the final result, or where they do not produce any advantage . . . or it is practically impossible to obtain what is required and observe such forms, a statute requiring competitive bidding does not apply.' Our courts have approved this doctrine."

In McQuillin on Municipal Corporations, Vol. 2, sec. ed. Revised, p. 1182, sec. 1292, it is stated with citation of cases: "Provisions as to competitive bidding have been held not to apply to contracts for per-

sonal services depending upon the peculiar skill or ability of the individual, such as the services of . . . an attorney at law, a superintendent or architect . . . or a consulting and supervising engineer. And generally the requirement does not apply to the employment of a professional man, in which case the authorities have

a discretion as to his qualifications."

In Miller vs. Boyle, supra (43 Cal. App. 39), the following was quoted with approval at page 44: "An architect is an artist. His work requires taste, skill, and technical learning and ability of a rare kind. Advertising might bring many bids, but it is beyond peradventure that the lowest bidder might be the least capable and most inexperienced, and absolutely unacceptable. As well advertise for a lawyer, or civil engineer for the city, and intrust its vast affairs and important interest to the one who would work for the least money." This court in San Francisco vs. Boyd, supra (17 Cal. 2d) said at page 620 that "The employment of a person who is highly and technically skilled in his science or profession is one which may properly be made without competitive bidding.

No question is raised as to the power of the city under its charter to proceed in the matter of sewage reduction, treatment and disposal (see City of Oakland vs. Williams, 15 Cal. 2d 542, at 550) and the record shows that since the adoption of the new charter the Department of Public Works, the chief administrative officer, and the Board of Supervisors have so construed its provisions as not to require that contracts for expert and professional services be subject to the civil service provisions or the procedure of competitive bidding. The practice has been for the director of public works to make such contracts with independent contractors upon the approval of the chief administrative officer and without advertising for bids. There is no language in the charter which may be said to require a different method of procedure. Therefore it follows that the contract involved is valid.

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Crusher plant, concrete mixer in foreground.



Mr. Roths, county engineer, inspects plant operation.

County Operated Quarry and Crusher Save \$30,000 Yearly

By ELMER J. ROTHS

County Highway Engineer, Sebastian County, Ark.

S EBASTIAN COUNTY, Ark., owns and operates its own quarry and rock crusher. We produce all of the aggregate used in building and maintaining our 750 miles of county highways and farm-to-market roads. The quarry, which is located near Fort Smith, furnsihes a hard sandstone. We cut away the 3-ft. overburden with a 1½-yd. shovel and bulldozer and remove it in 3-yd. dump trucks.

The underlying sandstone has an average thickness of 12 ft. We drill ½-inch holes, staggered every 4 ft., and shoot with 60-40 dynamite. The rock is then loaded into cars and pulled to the crusher, or is hauled out by 3-yd., 1½-ton dump trucks. The crusher is located about 300 yards from any operations area, and the conventional method of crushing is used. The rock goes first to a 10-A jaw crusher, from which it is carried by bucket conveyor belt, consisting of 120 steel buckets on a 14-inch belt, to the auxiliary crushers and screens; and by other conveyor belts to the four storage bins where it is graded as to size.

The entire operation is carried on with 17 men: 3 truck drivers, 5 rock-breakers and loaders, 3 air-tool operators, 1 shovel operator and 5 men at the crusher. With these 17 men, we remove from the quarry and crush, in an average day, 400 yards of rock.

The main crusher plant is powered by a 90-hp. gas engine, with a 60-hp. starting motor. This engine also operates a wire rope hoist which is used for pulling the loaded cars from the quarry floor to the crusher. On this hoist, we use 34-inch, wire center improved plow steel preformed wire rope, which gives us long service. Before using this type of rope, we had considerable trouble with kinks and some hand injuries. The preformed rope eliminated the kinks and also the troubles with hand injuries, as broken surface wires in this rope will not flare out to form barbs.

A second wire rope hoist operates a conveyor which takes stone from the crusher bins to a stationary concrete mixer, which is also used as a cut-back asphalt mixer. A 2,000-gal. asphalt tank is located alongside the mixer. Besides the stationary mixer, we have 3

portable concrete mixers, and also own and operate 2 portable crushers, one a 10x20 and the other a 9x16.

We figure we save 40% on concrete and asphalt work by having our own plant. At current area prices, black top would cost us \$5 per ton, while we produce our own for \$3 a ton. On a mile of road, requiring 650 tons of black top, this represents a saving of \$1,300. Our quarry operations produce between 40,000 and 50,000 yards of crushed rock a year, all of which meets state highway specifications. We produce four grades, running from 14-inch and smaller to 3-inch. At present prices, crushed rock costs \$2 per yard locally. Allowing for maintenance and repair, and for a reasonable depreciation, we figure we can produce our own aggregate for 94 cents per cubic yard. Adding to this a 20-year amortization on the quarry site, buildings and fixed equipment, and we can still show better than \$30,000 yearly savings on our quarry and crusher operation.

The major equipment used in our quarry and crush-



Joe Hardin, county road commissioner.

ing operations include: One 10-A Telsmith main breaker; two Austin-Western gyratory crushers; one 90-hp. Lazier gas engine; one 60-hp. Caterpillar starting motor; elevators; screens; hoists; conveyors; two portable Iowa jaw crushers; one 21-E Rex concrete and cut-back asphalt mixer; one 14-S Koehring concrete mixer; one 10-S Foote concrete mixer; one D-5 Blyston mixer; one Cleaver-Brooks tank car heater; one 1½-yd. Byers shovel; one International bulldozer; one front-end Caterpillar loader; one Sullivan air compressor; one Ingersoll-Rand air compressor; sizek hammers; three Hercules blasters; one John Deere tractor; two Federal dump trucks; and three 3-yard Ford dump trucks.

Lightweight Aggregates for Concrete

RDINARY concrete, with sand and gravel aggregates, weighs about 150 pounds per cubic foot. Information regarding lightweight aggregates has been collected by the Construction Branch of the National Housing Agency, and a testing program will be developed. "Lightweight" concrete is an elastic term, and one that has changed almost constantly. It was first used in connection with concrete using haydites as aggregate and meant a concrete weighing about 120 pounds per cubic foot. In more recent years, using such natural aggregates as perlite and vermiculite, efforts have been directed toward producing satisfactory concrete weighing as little as 50 pounds per cu. ft. Desirable properties are light weight, nailability, ease of cutting and channeling and good insulation to both sound and heat.

The range of weights possible by using different aggregates are:

Type of Aggregate	Aggregate Weight Wei per cu. ft.	ight of Concrete per cu. ft.
Gravel	120	150
Sand		150
Crushed stone	100	145
Crushed bank slag		110-130
Haydite		100-120
Foamed slag		90-100
Cinders		110-115
Pumice		60-90
Diatomite	28-40	55-70
Perlite		40-65
Vermiculite		25-50

Haydite is an expanded shale or clay. Fine haydite aggregate (from dust to 3/16") weighs about 60 pounds per cubic ft., while the coarse size (3/16" to 3/4") weighs about 40 pounds per cu. ft. A standard masonry block, 8"x8"x16", using haydite aggregate, weighs about 27 pounds. The range in weight, from about 40 to 60 pounds per cu. ft., is apparently due to variations of materials between plants and the voids in the aggregate. Prices quoted by a number of plants ranged from \$3 to \$20 per ton and \$2 to \$16 per cubic yard. There are seven or eight firms engaged in the manufacture of this material.

Expanded or "foamed" slags are made by treating hot molten blast furnace slags with controlled quantities of water. Methods of production vary widely. With just the right amount of water, a slag is produced that weighs 45 to 60 pounds per cu. ft. and has a pleasing light color. In practice, the weight may

range from 30 to 60 pounds per cu. ft. and prices vary from \$1.50 to \$5 per ton or \$1.20 to \$3 per cu. yd. This material is produced by seven or eight firms.

Pumice, and its volcanic relatives, pumicite and tuff, are siliceous materials of volcanic origin. Pumice looks like a glassy froth and pumicite like a very fine closely packed glassy sand. About a dozen firms produce this material, which weighs, mill run or pit run, from 41 to 61 pounds per cu. ft. Screened aggregate weighs 28 to 38 pounds per cu. ft. and sells for \$5 to \$20 per ton—much higher than for the mill run material.

Diatomite consists of the deposits of the siliceous shells of microscopic aquatic plants called diatoms. Pure diatomite has a weight of 28 pounds per cu. ft., but admixtures of clay, sand, or gravel may considerably increase this weight. On the other hand, some deposits are much lighter, one in Nevada reporting an aggregate of ½" to ½" size, weighing 16 to 20 pounds per cu. ft. This sells for about \$5 per ton. Few producers are reported.

Perlite is one of the natural volcanic glasses and is related in origin to pumice. Production of this material is a relatively new industry, with about a dozen firms engaged in it. Weight of perlite aggregates are reported to range between 2 and 16 pounds per cu. ft., and apparently depends on the amount of fines as well as on the source of the material. Prices are reported to range from \$2.75 to \$14 per cu. yd.

Vermiculite is a micaceous mineral. The dried, ground ore is subjected to high heat for a very short time, resulting in an expansion to as much as 30 times its original volume. Originally used for "loose fill" insulation, it has more recently been developed for a lightweight concrete aggregate. It is reported to weigh 6 to 12 pounds per cubic ft. Somewhat more than 20 firms produce this material which is reported to sell for from \$5 to \$27 per cu. yd., or \$37.50 to \$103 per ton.

Additional information regarding lightweight aggregates are available in the following publications of the Bureau of Mines, U.S. Department of the Interior, Washington, D. C.: Lightweight Aggregates for Concrete, by F. T. Moyer, Information Circular 7195; Pumice and Pumicite, by Paul Hatmaker, Information Circular 6560; Perlite, Source of Synthetic Pumice, by O. C. Ralston, Information Circular 7346; and Marketing Vermiculite, by C. R. Gwinn, Information Circular 7270. The information contained in this article was taken from a survey made by the Office of the Housing Expediter, Washington, D. C.

1946 Cost Data on Highway Construction

Average bid prices for highway construction during 1946, utilizing Federal-Aid funds have been tabulated by the Public Roads Administration. The prices showing the average for the year are followed, below, by the costs for the last quarter of 1946, in which some items were up quite materially Roadway excavation: Borrow, 58 and 65¢ per cu. yd.; common, 32 and 40¢; unclassified, 40 and 45¢; rock, solid, \$1.14. Structural excavation: per cu. yd., common, dry, \$2.46 and \$3.40; unclassified, \$2.85 and 2.86. Steel: structural reinforcement, 7.2¢ lb. and 8.1; structural steel, 9.9¢; pavement reinforcing, 5.7¢. Structural concrete: superstructures, \$38.64 per cu. yd., and \$42.21; substructures, \$36.63 and \$39.28; foundations and footings, \$33.77 and \$36.03.

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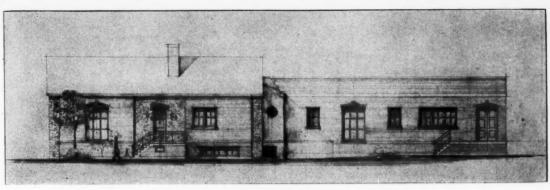
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Architect's drawing of the remodeled Negaunee plant building

Negaunee Modernizes Its Waterworks

Electrification results in \$20,000 savings during the first year. Old buildings are made attractive. Filter plant and elevated storage planned.

By J. BENJAMIN VERHOEK

Principal Assistant Engineer, Greeley and Hansen, Chicago, Illinois

EGAUNEE, Michigan, is in the midst of a program, conceived as far back as 1931, for improving its water supply facilities. This city has about 7,000 population and is located in the center of the Marquette iron ore mining district. Practically the only local industry is iron mining, which not only supports the community but accounts for about 40% of the water use.

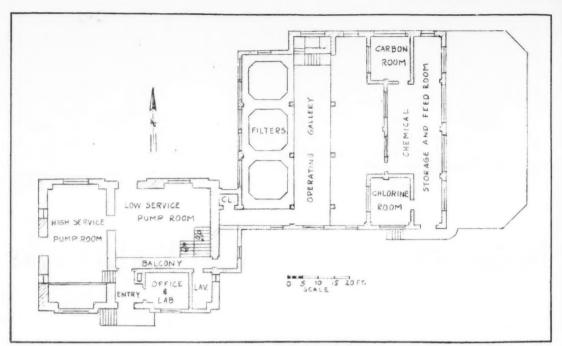
For many years the city has obtained a fairly satisfactory supply of water from Teal Lake in the northwest section of the city. Though the lake is fed chiefly by springs, the water is quite soft, the total hardness varying from 40 to 70 parts per million. The lake has an area of about 550 acres and an average depth of about 25 feet. It lies entirely within the city limits, so that it has been possible for the city to protect it from any appreciable contamination by restriction of use of the lake for recreational purposes.

Prior to the start of the present modernization program, the waterworks comprised an intake and steam pumping station, originally operated in conjunction with a municipal electric power plant; but by 1930 all local power was purchased. Shortly after this, the generators were sold and the water supply pumps were the only remaining load on the boilers. The pumps consisted of one Prescott triple expansion duplex pumping engine and two Worthington compound duplex pumping engines. All three engines had seen many years of service. Water was pumped directly from the lake into the mains with only the addition of chlorine for disinfection and soda ash for control of the alkalinity. There was no storage, either underground or elevated.

The chief motivation for improvement of the waterworks was the growing demand for development and use of the lake for bathing and other recreational purposes. A secondary reason was the desire to reduce the turbidity of the water, which at times was rather high. In 1931, before proceeding with plans for improving the waterworks, an investigation was made of two other possible sources of supply, Dead River 7 miles, and Morgan Creek 5 miles, from Negaunee. The total annual cost for either development would have exceeded that for the improvement of the Teal Lake supply so neither was given further consideration. The program for improvement set up for the Teal Lake supply included electrification of the pumping station and construction of a filter plant and an elevated storage tank, together with some reinforcement of the distribution system. The depression and the war, however, caused postponement of the entire program.

By 1943 two other factors had entered the picture, obsolescence and rising coal costs. The boilers and engines were in need of major repairs; the boiler economizers were no longer usable. The trestle by which coal had been delivered in carload lots had been dismantled, so that all coal had to be delivered by truck to the plant at greater cost. It was obvious that a major investment was necessary. Studies indicated a probable saving of about \$15,000 a year if the steam equipment could be replaced by electrically driven equipment. Construction to convert the station to electrical operation was started in the summer of 1944.

The boilerhouse and pumping station consisted of an old stone building, with walls two feet thick, which had housed the original Worthington pumps in one room and the turbo generators in another room. To this original building three wings had been added, all with brick walls. The north wing housed the Prescott pump; the south wing an office and lavatory; and the east wing the boiler room. It was decided that the original stone building was worth saving, but that the three wings should be demolished for the sake of appearance. The room housing the Worthington pumps was large enough for the high service pump room; and the other room, formerly housing the generators, could



The floor plan of the remodeled Negaunee plant.

be divided into a low service pump room and an office, laboratory, and toilet.

Installation of Electrically Driven Pumps

The first section of the over-all improvement comprised the replacement of the steam pumps with electrical and gasoline engine driven pumps; remodeling of the high service pump room interior, and the office and laboratory portion of the low service pump room; removal of the two small wings, and dressing up of the exterior. Most of the work was done by regular city employees and pensioners, retired miners no longer able to work in the mines, but still able to handle light work.

Since there was no elevated storage on the distribution system, the periods of shutdown of the plant had to be held practically to zero and the work carefuly planned to have adequate operating and standby equipment in working order at all times. In addition to the equipment that had to be furnished, the city had on hand a 2,000 gpm. motor driven pump which had never been installed. This was too big for normal use, but was suitable for standby purposes if the motor could be replaced with a gasoline engine. To do this, the motor was removed and a V-belt pulley with bearings and supports was substituted. A Climax gasoline engine to drive the pump was then ordered. Only after arrival of the engine was any steam pump taken out of service. Then, one of the Worthington pumps was removed, leaving the Prescott in service and the other Worthington as a standby, while the gasoline engine and pump were being installed. After the gasoline unit was in place, connected to the piping, and ready for operation, the second Worthington pump was removed, leaving the Prescott in service and the new gasoline unit as standby while three electric motor driven pumps were being installed. These pumps were manufactured by the American Well Works and were of 500 gpm., 700 gpm., and 900 gpm. capacity. The average daily water pumpage is about 1.2 mgd., so that the station, exclusive of the gasoline engine unit.

has an installed capacity of $2\frac{1}{2}$ times the average daily requirements. After the motor driven pumps were in operation the Prescott engine was removed. The piping was so designed that the above operations could be carried out with practically no shut-down. Other equipment was installed, consisting of two Yeomans vacuum pumps, one motor driven and one gasoline engine driven; a Sparling propeller type master meter; and a Syntron dry chemical feed machine for feeding soda ash to the water. Two Wallace & Tiernan chlorinators were moved to a temporary room in the future low lift pump room, from where they will be moved again when the filter plant is built.

Renovating the Building

While the mechanical remodeling was being done, the architectural work also went forward. The improvement in the appearance of the interior is almost unbelievable. The original walls were covered with a dark wood wainscoting to about 8 feet above the floor, and the rough stone was exposed above that point. The windows were small and there was no ceiling, the roof trusses being exposed. The combination of small windows, thick walls, dark finish, and dark space up in the peaked roof made the interior very dingy. In the remodeling process, the wainscoting was removed and replaced with buff colored glazed ceramic tile. A suspended ceiling was installed just above the windows, and the ceiling and upper part of the walls covered with ivory colored acoustical plaster. At the two ends of the room where the wings were removed there were large openings in the original walls. In each of these openings, a large window was placed and the remainder bricked in and faced with tile. The floor was covered with taupe colored quarry tile. At the south end of the room there was some unsightly electrical equipment used for control of the street lights. This equipment had to remain in place, so a tile wall on a steel framework was built in front of it to hide it. The office and laboratory were constructed

(Continued on page 43)

Texas Sewerage Practices

A review of portions of the Manual for Sewage Plant Operators of the Texas Water Works and Sewerage Short School

THIS Manual is a text book of 435 pages, containing 27 chapters and 5 appendices. Though practically each chapter was prepared by a different man, specially fitted to discuss the subject, the whole has been admirably edited by L. C. Billings. All of the material is sound; much of it has a Texas viewpoint, which is proper since it was prepared primarily to serve in the educational and training program that is being carried on so effectively in that state.

Several of the chapters cover practices more or less confined, for the present, to Texas. Some of these chapters will be reviewed here. The other chapters, covering generally standard practices, will not be discussed.

Sewage Irrigation

Land disposal, or irrigation, should be used only as a secondary treatment or disposal method. The minimum treatment, if land disposal is to function effectively, is coarse screening plus primary sedimentation, with a detention period of 1.5 to 2 hrs. Favorable conditions for disposal are low annual rainfall, high temperatures, winds and high evaporation. Coarse textured land, loose in structure, and with low ground water table, are especially desirable though there have been some cases where land disposal has been successful with comparatively heavy soils.

Where the disposal of the sewage is the primary or only purpose of irrigation and crops are not grown, the disposal area is divided into several fields, each in turn receiving the sewage for a period of one day to several days. Methods of distribution of the sewage to the land should generally conform to prevalent local methods and standards of irrigation, with the furrow method being preferred. Cleaning, cultivation and resting of the fields are essential.

The amount of liquid that an area will take can best be determined by a percolation test over a period of one to three days. It is usually safe to apply half as much sewage as was determined by the clear water percolation test, if beds are permitted a rest period for drying, cultivating and reaeration of about six times the number of days of application. In tight soils, the load per acre per day will probably be 5,000 gals. or less. In loose-textured soils and areas of high evaporation, 25,000 gals. per day is not uncommon.

When agriculture is the primary purpose, considerable additional area is needed to care for disposal when crops do not need the water. A holding tank, usually of earth, with a capacity of several days flows, permits night and unneeded flows to be stored.

Main distributing or carrying ditches should be lined with concrete, or should be of pipe or half pipe. Dirt ditches permit accumulation of sludge, development of vegetation, and odors. The area irrigated should be leveed to prevent escape of the sewage to adjacent streams. Mosquito control may be necessary.

Wet sludge, after digestion, may be discharged with the sewage into the ditch or pipe and onto the land. It should be diluted with the sewage before application so that a deposit no greater than one or two inches in thickness occurs anywhere,

This is an abstract of Chap. VII, which was prepared by J. P. Burden, city engineer of San Angelo.

Lagoons and Ponds

This subject is treated in both Chap. VII and Chap. XX, the latter prepared by Ashley G. Classen. Settleable solids should be removed prior to discharge into the pond or lagoon, though Kingsville, Tex., has used a lagoon successfully for several years as a means of complete treatment. Generally a lagoon should be not less than five miles from any concentration of population. Mr. Classen recommends a capacity sufficient to provide detention for at least six months, whereas Mr. Burden suggests up to 20 days detention. Depth should not exceed 10 ft., but should not be less than 4 ft., to prevent bottom growths. The BOD loading recommended by Mr. Burden is 20 to 40 pounds of BOD per acre-foot per day. Overloading the ponds may cause odors. Mosquito breeding may be a problem and vigorous methods of control may be necessary, and should be provided for.

The Dunbar or Sand Filter

The Dunbar filter is used by some 50 Texas municipalities. It consists of a top layer of 18 or 20 ins. of sand, placed on two 4 to 6-inch layers of graded gravel, and underlaid with about 24 ins. of 4 to 8-inch stone. This is placed in a concrete tank. Individual beds are about 30 ft. wide and 120 ft. long. The sewage is fed onto the surface of the bed by means of a distribution box or trough, and feeding is continued until the surface ponds to a depth of 4 to 6 ins., when the flow is switched to another bed. After the ponded liquid has seeped through the bed and the surface has dried, it is scraped and loosened.

At rates of operation up to 2 mgad, an 85% reduction in BOD can be expected; a rate of 1.3 mgad is considered optimum, providing good nitrification and high dissolved oxygen in the effluent. Clogging of the bed may be expected after the application of about 8 mg of settled sewage per acre of bed surface.

The Dunbar filter is discussed in Chap. XIII, which was written by S. M. Field, assistant city engineer of Amarillo.

Other Chapters

Other chapters were prepared by W. S. Mahlie (sewage composition, chemistry and biology); G. W. Cox; H. R. F. Helland (sewer main design); H. M. Bohn (pumps and lift stations); R. U. Andrews (sewer maintenance); R. E. McAdams; J. D. Fowler; L. J. Trotti; Lewis Dodson: Terrell Bartlett; E. J. Umbenhauer; R. M. Dixon (trickling filters); E. J. M. Berg (activated sludge and separate sludge digestion); S. L. Allison; G. L. Fugate; I. M. Dietz; L. C. Billings; C. H. Billings (industrial wastes); C. C. Hays; W. P. Walker; J. H. Sorrells; P. J. A. Zeller; and V. M. Ehlers, to whom the volume is dedicated in

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recognition of his long and outstanding service in public health.

This book ought to be in every engineer's library, because it contains a lot of standard information that is well arranged, especially for the sewage plant operator; and also because it covers especially thoroughly conditions and practices in a state of steadily growing importance. Write to Mr. Ehlers, Austin, Tex., for information on how to get a copy.

Treating Distillery Wastes and Abating Stream Pollution

The Illinois Sanitary Water Board recently announced action by the American Distilling Company to abate Illinois River pollution resulting from the discharge of distillation residues, resulting from whiskey manufacture, from the company's plant at Pekin, Illinois. A series of studies and conferences between the company and technical personnel of the Sanitary Water Board has resulted in the present improvement and expansion program.

In commenting on the installation, C. W. Klassen, Technical Secretary of the Board, stated that the installation, when completed, will recover a valuable livestock feed from the wastes. It is calculated that the proposed plant will recover pollutional material equivalent to the domestic sewage from a city of approximately 575,000 persons. The program contemplated by American Distilling Company consists of improvement of existing feed recovery equipment and addition of equipment which will effect complete recovery of all solids contained in the distillation residues when the plant is operating at capacity production. New equipment proposed consists of the following: 5 Davenport screens of sufficient capacity to handle the slop from a grind of 16,000 bushels per day; 5 Davenport presses of sufficient capacity to handle the slop from a grind of 16,000 bushels per day; one U.S. Pipe and Foundry Company quadruple-effect evaporator sufficient to handle the thin slop from a grind of 12,000 bushels per day. An existing evaporator and drier is being reconditioned and the over-all feed house capacity when this installation is completed will be sufficient to handle the distillation residues from 16,000 bushels per day. The plant is approaching the latter stages of construction at the present time and it is anticipated

that it will be placed in operation in the late spring of this year

The American Distilling Company has had in operation for a number of years, a feed recovery plant for a portion of its process wastes which reduced the pollutional load by an amount equivalent to the domestic sewage from 120,000 persons. The new installation is the final increment in the stream pollution abatement program of American Distilling Company and is the result of considerable study and research on the part of that organization.

In commenting upon the industrial pollution abatement program of the Illinois Sanitary Water Board, Mr. Klassen stated, "The action taken by American Distilling Company is illustrative of the excellent cooperation which this Board has received from Illinois industry. Abatement of stream pollution is, of course, the objective of this Board; however, the recovery of by-products from waste material has been a definite part of our program. We feel that a double purpose has been served when, as in this instance, it is possible to abate stream pollution and at the same time recover by-products from the waste."

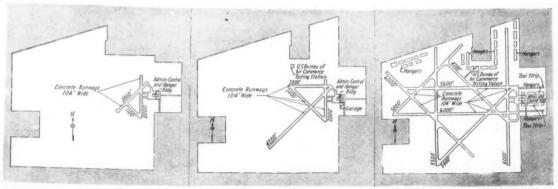
California Practices for Highway Foundations

As traffic weight and wheel load repetitions have increased, California has increased its standards for foundation design. In a recent paper before the AASHO, R. M. Gillis, Construction Engineer stated that:

The thickness of base and pavement for less than 5 California Bearing Ratio is now 24 ins. Under portland cement concrete pavements, the state now tries to get 50 CBR, as against 20 CBR a few years ago; and under asphaltic concrete, an effort is made to get 80 CBR. A plasticity index requirement has been added for base material—usually less than 6 being specified.

Compaction requirements now require 90% relative compaction for all fills; in addition the top 2½ ft. below grade is placed in 4-inch layers, which with most materials will give 95% relative compaction. In cuts where material has less than 90% relative compaction, the cuts are rolled, or, if necessary, are taken out and replaced in 4-inch layers to insure compaction at least 2½ ft. below profile grade.

Stages in Airport Development at Indianapolis



Courtesy Portland Cement Assn.

The Indianapolis airport has been developed progressively as shown, runways being constructed as needed. Left, the first runways built; center, present status; right, the girport when the plan is completed.

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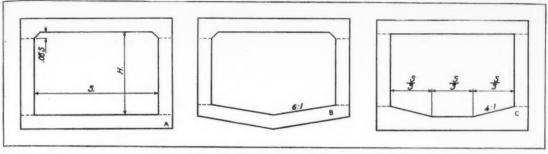
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Standard culvert inverts, left to right, flat, V and trapezoidal.

Culvert Design Factors

From 12% to 17% of highway costs may go into drainage structures. Some culvert problems and solutions are presented in this summary of a paper before the American Association of State Highway Officials.

By R. ROBINSON ROWE

Senior Bridge Engineer, California Division of Highways

CULVERTS have grown as highways have grown. As earthwork became cheaper and traffic demanded smoother alinement and grades, the culvert was buried deeper and deeper in the embankment. For every foot the highway was widened, one foot was added to the length of the culvert; but for every foot the grade was raised by filling, the culvert was lengthened three feet. At first, this made no great difference, but as the load on the culvert due to the fill became heavier, construction costs rose. To reduce costs, it has become essential to determine more precisely the hydraulic and structural duties of the culvert.

We consider that frequent flow under head involves undesirable risk of blocking the culvert by debris, or of erosion at the extremities, and we therefore require that flow will be without head for a 10-year flood. This requirement usually fixes the minimum water way at the entrance. A 100-year flood is then assumed and the design checked. For this flood, the culvert will usually flow full. Computations are made to determine stages and velocities at the extremities so that all appurtenances can be designed for this extreme flow condition. For instance, if a 10-year flood flow is 100 second-feet, a 4'x4' box culvert is used, as this will admit 100 second-feet without head on the entrance. Assume the 100-year flood flow is 180 second-feet. On a flat slope this may pond 8' deep at the entrance, and for this flat slope a larger section is used so that the pondage will do no damage. If the slope is somewhat less than the neutral slope of 0.009, the culvert will be filled throughout by the 180 second-feet and the 4'x4' section will constitute a good design. But if the natural slope is much steeper, the 180 second-feet will be ponded at the entrance, but the flow will drop just inside the entrance and the remainder of the culvert barrel will not be filled. In this case, a 3'x3' barrel with a 4'x4' tapered entrance may be adequate and much

This design procedure is most economical for long culverts, usually under high fills, for which barrel efficiency is more important than entrance efficiency. The proportioning must be done carefully; if the barrel is too large, the cost of the unused waterway will be excessive, and if too small, the cost of enlarging will be very great.

Culvert Inverts and Sections

An invert design that will not become plugged with detritus is important. Three kinds of inverts are used in California—the regular, the V and the trapezoidal.

The regular invert is a flat slab without corner fillets. This is the cheapest to build and is satisfactory with clear water or with any water if the culvert has a good grade and getaway. Otherwise, these culverts clog quickly with boulders and smaller detritus; maintenance is then expensive; and there is possibility of damage if another flood occurs before the culvert has been cleaned.

The V invert, with the slides sloping 1 on 6 toward the center, will transport detritus better than the flat invert type, as on the falling stage the flow is deeper in the V.

The trapezoidal invert is flat for the central third of the invert, with the outer thirds sloping 1 on 4 to the center. This invert can be struck with a screed, and though still considered experimental, is expected to maintain fair velocity in the falling stage, while dispersing erosion over the central third.

Curved alinement of a culvert raises the problem of superelevation to distribute boulders or detritus laterally and prevent erosion at the lower corners of the barrel. A curved invert section may satisfactorily disperse erosion, but model studies will be required for a final solution of this problem.

Fillets are not used on the lower corners of any of the above inverts, as these sections are considered rigid, but are designed hydraulically for the upper corners to obtain maximum capacity of flow. Triangular fillets on this basis are made 0.05 times the span in feet to the nearest inch.

Roughening to reduce the energy in the stream at the outfall is sometimes used. The interior surface of the culvert may be roughened by means of corrugations, or by other similar means; the invert may be laid as a series of long steps; or weirs or baffles may be constructed. This latter method is generally considered undesirable because it may trap debris and therefore can be used only for clear water streams.

Problems in Design

If the culvert gradient is steep, hydraulic efficiency would call for a very small waterway and a very high velocity. There is a reasonable limit to velocity, but if we try to reduce velocity by increasing the size of the water way, the barrel flows part full with the velocity still high. The ideal flow would be a filled waterway for most of the culvert, with the water surface dropping until there is critical flow and minimum energy at the outlet. The shape of the cheapest barrel, as a square box or a high arch, makes a dangerous and unnatural waterway when flows are large. For instance, suppose we are designing a box culvert for 1000 second-feet on a gradient that will support a velocity of 10 ft per second. The hydraulic engineer suggests a 20x5-ft, box culvert, but the structural engineer points out that a 10x10-ft. box would provide the same waterway at much less cost. However, to use the full area of this culvert, the stream must back up at the entrance and the extra 5 ft. of energy head may be very destructive at the outlet. With a high arch culvert, the energy head would be still greater. It may be said that a large culvert barrel consists of two segments, the lower segment being the usable waterway and the upper segment being a structural void. In the example cited above, the 10x10-ft. box culvert has a usable waterway of only 75 sq. ft.

Large drift must be screened to prevent it from entering the convergent throat of a tapered culvert, or it will choke the entrance and cause ponding, which in addition to depositing silt, may cause failure of the embankment. However, long culverts can be "slenderized" by a properly designed entrance. The saving in the cost of the culvert barrel must be weighed against

the extra cost of constructing the entrance.

At the outlet, the problem is to dissipate the energy of the water without damage to the structure, the embankment or downstream improvements. Flared outlets, hydraulic buckets or bank protection can be used

singly or in combination.

For either end, a transition from the natural trapezoidal waterway to the rectangular waterway of the culvert has been found advantageous in many cases. For this purpose, a warped wing wall has been quite generally used. The various types used are now being reduced to a few standard patterns.

Structural Factors

California structural standards of design are based on carrying the legal live load of the bare slab of the uncovered culvert. For small culverts, this is a more severe test than many feet of overfill. Designs have generally been based, for box culverts, on the culvert supporting the section of earth directly above it, with vertical lines of zero shear. Then each design has been rated for the two other conceptions of loading—lines of shear converging upward, which results in a small load due to overfill on the culvert; and lines of shear diverging upward, which may result in a tremendous load in the case of a deep fill.

California practice aims to insure that the culvert will settle more than the fill, which will result in upward converging lines of zero shear and no excessive load on the culvert. A blanket of cushioning material may be placed under the culvert, to act as bedding acts with a pipe in a deep trench; but where this is costly, the cushion may be placed on top of the culvert; or the

fill may be left uncompacted for a depth of several feet over the top of the culvert; or if compacted, it may simply be loosened in place. These alternative methods may reduce construction costs and simplify construction, for the rest of the embankment is built, as usual, over the cushion.

This paper appeared in California Highways and Public Works and the illustrations herewith are by the

courtesy of that magazine.

2, 4-Dichlorophenoxyacetic Acid

The chemical 2,4-dichlorophenoxyacetic acid commonly known as 2,4-D is an effective agent for the control of weed growth. Continued research is further clarifying its effectiveness on a variety of weeds and plants under changing conditions, 2.4-D in its free acid form is relatively insoluble in water, and while it may be used satisfactorily if dissolved in a "carrier" such as Carbowax 1500, it is more convenient to use in the form of the sodium salt which is readily soluble in water. The sodium salt of 2,4-D is a white powder, non-corrosive and non-inflammable. It is sold in the form of a stable monohydrate containing 6.9% water at relative humidity above 25%. The 2,4-D sodium salt monohydrate may be dissolved in the proportion of 1 lb. to 100 gallons water for common spraying purposes such as for use on lawns. Four to five gallons of this solution is applied to about 1000 square feet

A solution of 2,4-D containing as little as 1-1/3 ounces of the chemical in 10 gallons of water (1/10 of 1 per cent by weight) when used as a spray is deadly to many species of broad-leaved plants. The species on which it has been effective are: dandelion, plantain, poison ivy, chickweed, dock, ragweed, mustard, wild lettuce, bindweed, Canada thistle, white top, perennial sow thistle, quakegrass, Johnson grass, nutgrass, or other weedy grasses and sedges. It affects bent grass and anyone with a bent grass lawn should be cautious about this new treatment. A favorable feature of the 2,4-D spray is that it does not hurt Kentucky bluegrass, annual bluegrass, redtop, fescue, and buffalo grass. It will kill or seriously retard the growth of White Dutch clover.—Cenco News.

Water Plant Building Functional as Well as Attractive

The Longview, Wash., water treatment plant, which was rebuilt in 1945, is housed in an attractive building, which contains also a 40,000-gallon tank which supplies wash-water to backwash the filters. Water is taken from the Cowlitz River, and is treated by alum coagulation, sedimentation and filtration. A. H. Labsap is Manager of the Water Department.—Fairbanks-Morse News.



The modern building of the Longview water plant.

Public Works Engineering Methods and Data

Methods of Reducing Highway Construction Costs

A joint committee of the Associated General Contractors and the American Association of State Highway Officials have been studying methods of reducing costs of highway construction. Recommendations developed by the committee were reported by D. W. Winkelman of the AGC, as follows:

1. Eliminate hand labor items as much as possible, such as hand rubbing of concrete, fine grading, slope

2. Develop tolerances which will encourage maximum mechanization in grading, paving and other work.

3. Where feasible, particularly on secondary roads, reduce compaction requirements by permitting deeper "lifts" on fills. This is probably justified by the use of heavier modern construction and compaction equip-

4. Restudy earth compaction requirements with a view toward permitting greater tolerance in moisture content and material specifications.

5. Design concrete structures so as to permit the use of standard forms, thus saving labor and lumber. Research indicates that longer life in reinforced concrete structures results from larger sized members, and this also reduces the cost per cubic yard.

6. Use pipe culverts instead of box culverts where possible until the present situation eases. In areas of light rainfall, "dips" can be used temporarily.

7. Lengthen the working season by every device possible in plans, specifications and timing of lettings.

8. Set up projects which can be completed within one season.

9. Enforce any substantial changes in requirements. In some localities where changes have been made, contractors report that the hoped-for cost decrease did not materialize, due to failure to get word down the line from the top officials, or because of over enthusiasm for refinements on the part of field engineers and inspectors.

Photographic Reproduction Methods Speed Work in Minnesota

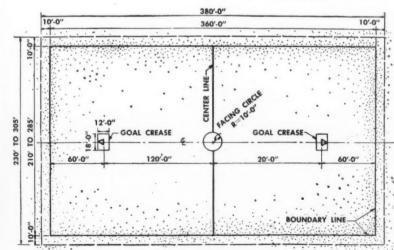
Little attention has previously been given to shortcut, labor-saving methods in drafting or drawing reproduction procedures, says the Minnesota Highway Department in its 1946 report. The shortage of engineers and technical aides that came with the war made it necessary to develop means of increasing production with curtailed forces. Investigation revealed that certain photographic processes could be used both to increase output and to decrease costs. The photo laboratory was reopened and placed in charge of an engineer with skill in photography in order that engineering uses could be developed.

An Ozalid Printmaster direct process reproduction unit and a Photostat photo copy machine were purchased. The former has been in operation for some time. Difficulty in obtaining material for a darkroom has delayed use of the latter. When both can be used, many manhours of drafting will be saved. Printing procedures will be much more flexible and service speeded up greatly.

A contract has also been let for a trial order to micro-film certain records. Such recording is desirable for two reasons. It provides protection against loss and releases much needed space now used for storage of old records.

Playground Layouts—Lacrosse

Courtesy OCE, WD, USA



LACROSSE GOAL

Boundaries of lacrosse field are marked with white lines. An extraheavy white line designates center line. Dimensions are to inside of lines except at center line. Lacrosse can be played on a football field.

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Trends in the Re-Use of Water by Industry

A summary of current practices in water conservation through treatment and re-use, abstracted from a paper before the Seventh Annual Water Conference sponsored by the Engineers' Society of Western Pennsylvania.

By CHARLES F. HAUCK,

Hall Laboratories, Inc., Pittsburgh, Pa.

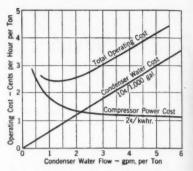


Fig. II. Hourly operating cost for purchased water and power.

FIVE years of subnormal precipitation during the middle 1930's resulted in lower ground water levels and diminished surface supplies. The past five years of peak consumption have further over-taxed and depleted some water reserves. Consequently, industries and communities nowadays look upon water supply as an engineering material which should be conserved. This can be accomplished through elimination of wastage and by re-use of water. Methods of conserving water through leak correction and economical usage will not be discussed in this paper. Attention will rather be centered upon ways to effect water thrift through re-use practices.

Re-use practice may be divided on the basis of first use into: (1) Re-use of process waters; (2) Re-use of water from cooling and heating circuits; and (3)

Re-use of sewage plant effluent.

The following procedure may be followed in uncovering re-use opportunities in water systems:

(1) Just as there exists a wide variation in per capita water consumption among municipalities, so are there marked differences in water usage by various plants in the same industry. A comparison of a particular plant's water consumption with the industries' maximum, minimum, and average requirements should indicate how efficiently the plant under study utilizes its water. Better consumption data will become available as the value of such guides are more generally recognized. Flow sheets [published by Chemical & Metallurgical Engineering | provide excellent reference data for water requirements in the chemical industries. The January, 1946, issue of the J.A.W.W.A. contains considerable data on other industries.

(2) A comparison of water quality requisite for

various plant purposes with the composition of water actually in use may reveal possibilities of re-use. Usually, it is uneconomical to use water of a better quality than necessary. For example, the Calco Chemical plant at Bound Brook, N. J., uses water of varying quality from five different sources for process requirements, namely, river water, well water, filtered water, treated water and distilled water.

(3) Where waste process waters must be conditioned before discharge, the practicability and economics of re-use with or without supplementary conditioning

should be explored.

(4) In all industrial plants, water is a real and sometimes substantial cost item. Therefore, consideration must be accorded to the possibilities of reclaiming sensible heat and usable materials as well as to the adequacy of supply when weighing the economic advisability of water re-use.

Re-Use of Process Waters

Conditioning of used process waters is becoming more widespread, especially in areas where treatment of industrial waste waters is required. Such re-use reduces waste water volumes and usually lowers the expense of waste treatment and disposal.

By greatly reducing the pollution problem, reclaiming valuable materials and conserving water, "savealls" pay a double dividend in paper plants. "Saveall" is a term applied to the method and means by which white water in paper mills is treated for fiber, filler, heat and water recovery. This may be accomplished by settling, screening, flotation, or filtration.

James Lowe, in Figure I, presents an analysis of savings realized at three paper plants through vacuum filter saveall operation. The net dollar savings realized from materials recovery are convincing enough without consideration of the favorable effects of saveall operations on waste water disposal and fresh water

requirements.

Following exploratory study on laboratory and pilot plant bases, a sludge blanket type precipitator was installed as a saveall at the Southland Paper Mills at Lufkin, Texas. Water supply for this ground wood and kraft pulp newsprint plant is obtained from five wells, 1,000 ft. deep. The saveall was placed in service in December, 1943, to condition waste water for re-use in the washroom. Average per day operating costs during the first six months were \$3.50 for chlorine, \$1.00 for repair labor and material, and \$2.36 for power, amounting to a total cost of \$6.86 per day, or \$0.51 per 1,000 gallons. In addition to obtaining low cost water, the plant conserved its limited underground water resources and removed a pollution load from the receiving stream.

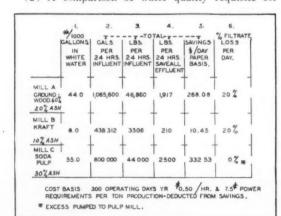


Fig. I. Saveall savings at three paper plants.



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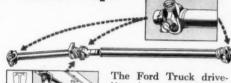




Tens of thousands of Ford Trucks have proved their endurance in the tough service of handling bulk building materials, ores, earth and coal. This 2-ton Dump Truck chassis carries a 3 to 4-yard heavy duty body and hoist by St. Paul. Hydraulic Hoist Division of Gar Wood Industries, Minneapolis, Minnesota.

ONLY FORD GIVES YOU ALL THESE LONG-LIFE TRUCK FEATURES: Either of two great engines, the V-8 or the SIX, both with full pressure lubrication to all main, connecting-rod and camshaft bearings, Flightlight oil-saving 4-ring pistons, precision-type heat-resistant bearings and fast-warmup temperature control • rear axle design that takes all weight load off the shafts (¾-floating in half ton units, full-floating in all others) • heavy channel section frames, doubled between springs in heavy duty models • big, self-centering brakes, with heavy, cast drum surfaces, non-warping and score-resistant—all told, more than fifty such examples of Ford endurance-engineering.

ONE Big Reason—
Ford Drive-Line Units
Stand Up!





The Ford Truck driveline is exceptionally enduring. Friction is minimized by needle

by relief fittings, in all universal joints in all models. Half-ton chassis have two such joints. All other models (except 101" w.b.) have three, and, in addition, a heavy duty ball center bearing. This bearing is self-aligning—cushion-mounted in live rubber. It is leakproof, excluding dust and water. It is unaffected by frame flexing and is notably long-lived. Large-diameter tubular steel propeller shafts with forged ends are properly balanced. This assures freedom from destructive vibration and great strength without excess weight.



NATURALLY, FORD TRUCKS LAST LONGER! Latest 1946 registration figures show that 78% of all 1936 model Ford Trucks in use 9 years ago are still on the job! That's up to 15.8% better than the records of the next four sales leaders—5% better than the average of all four. More than 100 bodychassis combinations. See your Ford Dealer!

MORE FORD TRUCKS IN USE TODAY THAN ANY OTHER MAKE

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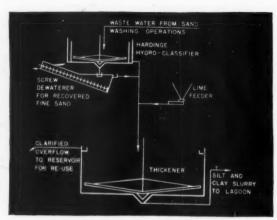


Fig. III. Treating waste water containing sand.

Gehm² has also cited a paper mill which saved \$177 per day in heating costs for process water. The mill water is treated for re-use by 30-minute clarifiation and subsequent polishing by sand filters. Within thirty-three months, the total first costs plus operating expenses for the period were recovered through fiber and heat savings alone.

An example, Figure III, of process water re-use in an essentially different field, involves recycling of wash water in a glass sand plant.⁸ This plant manufacturing glass sand was threatened with legal action due to its discharge of 900 gpm. of waste water which jeopardized the recreational value of the receiving stream. The solids contained in the waste water were approximately 1/3 fine sand and 2/3 clay silt. Through installation of a 15-ft. diameter hydro classifier and an auxiliary device for dewatering the recovered fine sand, approximately 25 tons of sand from minus 35 mesh down to plus 200 mesh are reclaimed each 10hour day. The effluent from the classifier flows by gravity after pretreatment with lime to a clarifying thickener. A 20% solids slurry is pumped from the thickener to a lagoon. The clarified effluent is recirculated by gravity to the plant water supply reservoir for re-use in sand washing, thus eliminating pumpage of 700 gpm. from a point 3/4 mile distant. Approximately 200 pounds of lime are required per day to maintain a suitable alkalinity in the water circuit.

Counter-current washing and rinsing operations in pulp and textile mills reduce fresh water demands and chemical wastage. Rinse water following dyeing can profitably be used in preparing new dye baths. Similarly, rinse waters following developer baths are suitable for making new baths. If mercerizing is done, the concentrated caustic rinse water has been economically employed as a starting material in making kier, wet-out or chlorine bleach liquors. Wash waters from wool deterging by the Duhamel process may be recirculated with attendant savings in water softening, pumping, soap, soda, and sensible heat. Sutermeister has suggested the use of waste spin bath to make up black liquor for the sulfate pulping process.

Condensate from heating and process steam sometimes has more value as process water than as boiler feed water. For instance, a large manufacturer of organic chemicals uses considerable condensate as process water.

Re-Use of Water from Heat Transfer Circuits

Water is commonly used for transporting heat from and to industrial processes and equipment. Recycling in such systems is very common. The return of condensate to boilers and recirculation of cooling waters have been practiced for many years.

Relatively large quantities of cooling water are required by condensers, for compressor jackets and other cooling applications. When treatment of such water is advisable or necessary, recirculation is often imperative, due to the excessive cost of conditioning water in large once-through systems.

In some areas, re-use of cooling water is mandatory by law. Seven states, Minnesota, Maryland, New Mexico, New York, Ohio, Utah and Wisconsin, control the use of water from both underground and surface sources. Regulation of water consumption can be enforced in four other states, Kansas, Massachusetts, North Carolina and North Dakota, when and if control is deemed desirable. Because all water entering the sanitary sewers at Miami Beach must be pumped, waste water flows exceeding 2 gpm. from air conditioning systems may not be discharged to the sanitary sewers. Therefore, water economy must be exercised. Cooling towers, spray ponds and economizers used in refrigeration or air conditioning installations require only the addition of sufficient water to the cooling circuit to make up for evaporation, blowdown and overflow losses. Comparative seasonal water requirements for a 50 hp.12 air conditioning system with a oncethrough system is 3,600,000 gallons as against 54,000 gallons if an economizer or cooling tower is employed. According to Wachter, "Generally speaking; economizers and cooling towers are justified when water costs exceed 15¢ per 1,000 gallons."

Ebaugh⁴ has graphically presented in Figure II the economics of operating an air conditioning system showing the inter-relationship between compressor power costs, and the rate of water flow to total costs.

Compressor cooling water has been used as boiler water makeup. Similarly, cooling water from furnace grates has been utilized as boiler water makeup. Economies in heat, water, and water conditioning chemicals are realized from such operations.

Occasionally, a collateral benefit results from recirculation through avoidance of "heat" pollution of the stream. Le Bosque of the U. S. Public Health Service, has called attention to the fact that if stream temperature is raised sufficiently by discharge of heated waters, normal stream recovery from pollutional loads may be impaired. It has been reported that one steel mill using 500,000,000 gallons of water per year increases the temperature of the receiving stream to a peak of 130°F.⁵

A large west coast steel plant situated in a semiarid region recirculates cooling water and re-uses effluent water from their sanitary and industrial waste treatment works. This procedure is followed because of limited raw water supply and the necessity of completely treating the plant's liquid wastes in order to avoid complaints from neighboring farmers. The only water leaving the closed potable and mill water circuits is through windage losses and blowdown. All cooling water passes through clariflocculators before going to the towers. Hardness of water in the mill circuit is controlled by shunting part of the water through a cold process softener. The sale of recovered phenol defrays a small part of the treatment costs.

Water thrift is also practiced by Republic Steel Company at Canton, Ohio. Recirculation of cooling water as well as re-use for other purposes prevails to an exceptional degree at this plant. For example, drainage from drinking fountains, and filter wash water are returned to the raw water reservoir. Even

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in a motor grader...no way in which any rear drive, front steer machine can equal the maneuverability, power-at-the-blade and allaround performance of the 99-H Power Grader.

Get the complete story of the many additional features of the 99-H from your A-W distributor, or send for the latest bulletin.

AUSTIN-WESTERN COMPANY, AURORA, ILLINOIS, U. S. A.





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boiler blowdown and ash spray waste water are retained in the mill water circuit.

Roll cooling water at the Revere Copper & Brass Company plant in Chicago is recycled after passing through a separator for removal of oil, grease and sediment and through heat exchangers. Neutralization and reheating for re-use of acid wash waters has solved the waste disposal problem and reduced water costs for a plastics plant.

The Talco Refinery in Texas treats its waste waters to prevent pollution and reduce fresh water needs. Primary and secondary oil separators followed by chemical treatment for freeing emulsified oil and precipitation of sulfides in sedimentation basins satisfactorily conditions the refinery's waste waters for introduction into cooling water circuits or release to the stream.

Cooling waters may also be recharged to underground formations for subsequent re-use. Such artificial recharge of underground supply is increasing in importance. Methods of planned replenishment of underground water resources have been described by Meinzer, Guyton, and Brashears of the U.S.G.S. Some years ago after the aquifier under the western half of Long Island had seriously diminished in yield, legislation was passed compelling the return of cooling water to the underground supply through recharge technique. According to Guyton, there are over 250 recharge wells being operated satisfactorily on Long Island and about 15 other wells being so operated in the rest of the country. Artificial ground-water recharge may also be accomplished by spreading areas, basins, or ditches. In California, artificial recharge by spreading areas over permeable terrain is practiced to a considerable extent.7 Klassen8 states that a large scale artificial recharge project is being planned in Indiana. River water will be pumped into a large basin excavated in gravel. The water will feed wells tapping this gravel formation. This replenishment operation will be limited to periods when the river water is of suitable quality.

Use of Sewage Plant Effluent

The use of sewage plant effluent for various purposes is becoming increasingly ordinary. Such application includes: (1) Use of sewage plant effluent by the plant itself in place of fresh water; (2) Use after supplementary treatment for industrial purposes; and (3) Use of sewage plant effluent for irrigation of crops in semi-arid regions.

Substantial quantities of water are used by sewage plants in regular operations such as hosing down tanks, dilution of heavy sludge, elutriation, etc. Sewage plant effluent is entirely satisfactory for such needs. At West Haven, Connecticut, sewage plant effluent is used for all operating purposes except drinking water. This practice, however, is discouraged and sometimes forbidden by State Departments of Health due to the hazards involved. Sewage plant effluent after screening and chlorination is used at the Chicago Southwest Plant in surface condensers as cooling water.

The outstanding example of employing sewage plant effluent as a substitute for industrial water is the Bethlehem Steel Company at Sparrows Point, Maryland. The water table of the underground supply from which the plant pumped 20 mgd. had receded from 10' in 1898 to 150' static level in 1940. Salt water contamination of this underground supply had also increased to serious proportions. After full study and investigations

tion, the Bethlehem Steel Company negotiated an agreement with the City of Baltimore to purchase 20 to 40 mgd. of effluent from the Back River Municipal Sewage plant. Treatment of the sewage plant effluent comprises flash mixing of a coagulant, flocculation, sedimentation and chlorination. The use of the sewage plant effluent resulted in curtailing the rate of withdrawal from the plant's underground water resources from 15,000 gpm. to 3,500 gpm. and restored the water table to a level of 80'.

At a mining operation in Mexico, approximately 355 gpm. of sewage and other waste waters are passed through an Imhoff tank and Dunbar intermittent sand filters. Of this total, 275 gpm. are then returned to the plant for flushing water closets and other plant operations.

The application of sewage to land is quite common in the Southwest and other arid regions. The estimated population contributing to such treated sewage irrigation projects is 852,000. The States of California and Utah account for approximately 75% of such usage.¹¹

Advantageous applications of water re-use can be discovered and evaluated through examination of water usage to determine whether: (1) Water consumption for the plant under study is above or below average for comparable plants in the same industry; (2) The variations in water purity required for various plant operations makes secondary usage practicable; (3) The net cost of waste water treatment can be reduced through application of re-use techniques; (4) The recovery of worthwhile quantities of heat and materials will result from re-use practices; and (5) The overall net plant water costs will be favorably affected.

References

- Waste Water Utilization by Clarification, Paper Trade Journal, August 16, 1945.
- (2) Waste Treatment Pays in a Paper Mill, H. W. Gehm, Wat. Wks. and Sewerage, March, 1945.
- (3) Private Communication, M. C. Fleming.
- (4) Conservation of Municipal Water Supplies in Air-Conditioning Systems, N. C. Ebaugh, J.A.W.W.A., February, 1946.
- (5) Conservation of Ground Water in the Louisville Area, Kentucky, J.A.W.W.A., June, 1945.
- (6) Conservation of Utilities in Republic's Canton Plant, P. L. Walter, Iron and Steel Engineer, May, 1946.
- (7) U. S. Dept. of Agriculture, Tech. Bull. 578 (1937).
- (8) Private Communication, C. W. Klassen.
- (9) American City, January, 1946.
- (10) Industry Converts Sewage Works Effluent Into Water Supply, W. P. Hill, Wat. Wks. and Sewerage, December, 1945
- (11) Public Health Reprint No. 2363.
- (12) The Use and Importance of Water in Refrigeration and Air-Conditioning, G. R. Wachter, Vol. 17, J., Penna. Wat. Wks. Oper. Assoc.

Cleaning Streets Really Clean

When the big snow storm hit Milwaukee last winter and a call for help went out to industries, the Heil Co. put into service several big trailbuilders that were awaiting shipment to distributors. A Heil Co. release says "The 'dozers successfully carved out many main arteries. In fact, neatly deposited along the high banks of one of the streets cleared by the mighty blades were large pieces of concrete and steel grated lights which were once safety islands. When these babies clean off a street, it's really clean."

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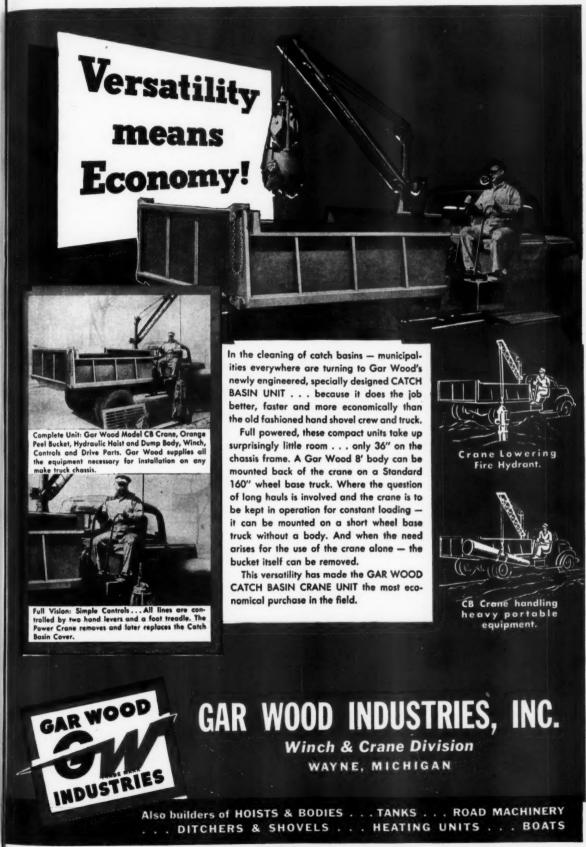
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TRICKLING FILTERS

Biofilters—description; loading; results of treatment; and design procedures.

This article was prepared by R. S. Rankin and coordinated by the editors of Public Works Magazine and consultant staff, including F. H. Waring, B. A. Poole, L. L. Langford, C. W. Klassen, J. J. Gilbert, R. E. Lawrence and S. L. Tolman.

BIOFILTERS is a term applied to high-rate filters, normally comparatively shallow, which employ presettling or detention of the sewage prior to its application to a trickling filter and the recirculation of all or part of the filter discharge back to the detention tank. The recirculated filter discharge may be filter effluent, or secondary clarifier contents, underflow or effluent.

The process permits reduction in the size or volume of the trickling filter by utilizing a dosing rate and BOD loading many times as great as is commonly used in low-rate filters. Recirculation of the filter discharge, which is high in dissolved oxygen, to the primary clarifier and mixing with raw sewage causes an initial reduction

in the ppm of the raw BOD essentially proportional to the weighted volumes and strengths of the raw and re-circulated flow. Repeated passage and recirculation of this sewage of reduced strength through the filter results in a further reduction to a somewhat lower BOD than would result from a single passage. In the process, the filter is the source of oxygen while the detention tank serves to complete the process of stabilization. Another advantage is the elimination of septic conditions in the primary clarifier, due to initially septic sewage or to excessive retention at low flows. Scum formation in the primary clarifier is greatly reduced by the dilution of the raw sewage with filter discharge. This reduction is particularly

noticeable in strong sewage carrying more than normal scum-forming materials.

The Biofiltration process was conceived by Harry Jenks; following several years of experimentation, the first full-scale plant was placed in operation in 1936. Since then over 250 plants employing this process have been installed or contracted for throughout the world. The process is patented, but nine representative companies in the United States are licensed at present under this patent and royalties are moderate.

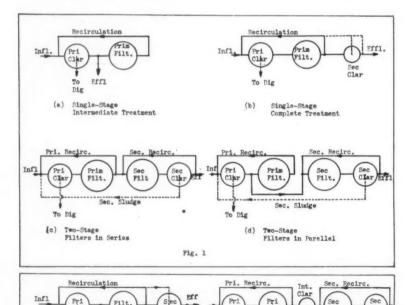
Flowsheets And Stages

This process may be employed in either single-stage or multi-stage plants. The single-stage plant may be used without a secondary clarifier for pre-treatment or as a roughing filter combination. In such applications it will produce, with normal biofilter loadings, an overall BOD reduction of around 60-65%. Where the secondary clarifier is added, overall removals are from 85 to 90%. Where two-stage filters are used, overall reductions of 90% and over can be obtained. Typical flow-sheets employing the Biofiltration Process are shown in Fig. 1.

A variation from the foregoing flowsheets, particularly for single-stage plants is possible by using the Ward Process, which involves the recirculation of secondary clarifier contents, underflow or effluent back to the filter feed. Nine representative companies in the United States may grant

licenses under this process. The Ward process may be combined with the biofiltration process. In the latter, all of the recirculation in a single-stage plant, for example, is returned to the feed to the primary clarifier. This will require an increase in size of the primary clarifier to han-dle the addition of the recirculated flow. Where this recirculation is taken from the filter discharge direct, it results in less flow going to the secondary clarifier and a smaller unit can be used. By using both the Ward and the Jenks processes, primary and secondary clarifiers of identical size can be used. as shown in Fig. 2a. A two-stage plant combining both processes is illustrated in Fig. 2b.

So far as overall BOD reduction through a single-stage plant is concerned, there appears to be no measurable difference which method of



Biofilter layouts.

Fig. 2

Two-Stage, Series with Intermediate Clarifier

Recirculation

Single-Stage, Complete Treatment Dual Recirculation ge carrying

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recirculation is employed. That is, the entire recirculation may be from filter discharge to primary clarifier influent, rit may be all from secondary clarifier effluent to filter feed, or it may be a combination. The advantages of using the combination or dual recirculation, as in Fig. 2a are as follows:

a. Septicity in primary clarifier is prevented:

Scum formation in primary clarifier is greatly reduced and often eliminated:

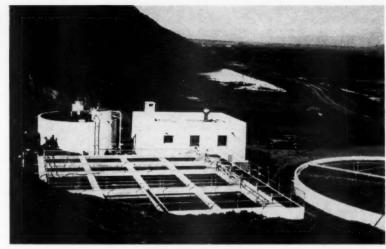
Both primary and final clarifiers may be of identical size;

d. During an emergency, should the primary clarifier be shut down, the secondary can serve temporarily as a primary.

Frequently, where the raw sewage must be pumped, recirculation from he filter discharge to the wet well can e regulated automatically to maintain minimum pumping rate to the primary clarifier. This was employed at number of military installations and complished the dual object of mainaining a fixed minimum flow while woiding the installation of another umping station.

Two-Stage **Treatment**

Where the raw sewage is strong over 250 ppm BOD) or where a high grade effluent (20-30 ppm) is required, wo-stage treatment will give better results and usually proves more ecoomical than an equivalent singe-stage installation. For this purpose, flowheets shown in Figures 1c 1d and 2b have been widely used. Flowsheet Fig. c, is employed at the Liberty, N. Y. plant where excellent results have been Itration Pro-btained for seven years, as noted in veral articles in this magazine. Flowheet 1d has likewise been used in nany plants with unusual success. It



Biofilter plant at Camarillo, Calif.

should be noted that the primary filter discharge is settled in the primary clarifier as is done in Flowsheet Fig. la, and primary clarifier effluent is fed to the second stage filter as well.

The NRC report commenting on this flowsheet which was used under favorable climatic conditions at Camp Roberts, Calif., says "Filter loading was highest of all trickling filter plants surveyed. Nearly three times the BOD load specified in the manual was applied to the primary filter. . . . Theoretically, this recirculation scheme is particularly effective in bringing about an optimum distribution of the daily organic load between the first and second stage filter in a two-stage plant. Results corroborate this conclusion. . . . The effluent discharged over a step aerator into Salinas River, which was virtually dry during four or five months of the year."

Numerous other flowsheets for multi-

stage plants have been used. A particularly novel one has been developed recently by H. A. Trebler, engineer for National Dairy Products. It includes a two-stage plant entirely in two structures instead of the usual four indicated by the flowsheets. It employs a single tank with a diaphram for the two settling tanks and two concentric beds served by a single distribuor for the two stages of filters. The idea may find application in treatment of industrial wastes and in smaller communities.

The foregoing discussion has included clarifiers or settling tanks in combination with filters. This is because sedimentation is an integral part of biofilter operation. Tests by Levine ("Sewage Works Journal" 1936, Page 701) and by the Upper Mississippi group show that of the total BOD removed by a high-rate filter combined with a sedimentation unit, filters removed from 55 to 70% or 80% and the sedimentation unit from 20% or 30% to 45%. One factor which improves performance of the secondary sedimentation unit is continuous removal of the humus or secondary sludge. This sludge quickly becomes septic and, unless removed, lowers the oxygen content of the secondary liquid. Primary and secondary clarifiers are now customarily designed on the basis of 800 gallons per square foot per 24 hours based on average daily feed to the tank less any quantity which might be withdrawn from the sludge or underflow pipe. Some State Boards of Health vary these ratings somewhat and it is necessary to check with these authorities for final size determinations.

Drainage and Ventilation

The high rates of application both liquid and biologic require that particular attention be directed to rapid drainage and good ventilation. Both of these objectives can be obtained by using any of the special underdrains previously described ("Public Works" March 1947), but some added features

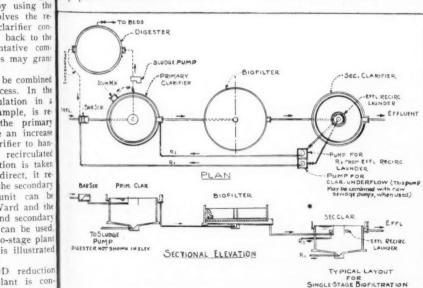


Fig. 3-Typical layout of biofilter plant.

employed in stage plants. ay be used ier for prefilter comions it will ter loadings, of around lary clarifier are from 85 e filters are f 90% and ypical flow-

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be combined cess. In the lation in a mple, is rethe primary an increase rifier to hanrecirculated tion is taken direct, it rehe secondary unit can be Vard and the nd secondary can be used, o-stage plant

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are of definite benefit. While these underdrains provide ample capacity for liquid and air; and the central gutter with proper freeboard provides an ample duct for the lower end of the system, additional outlets (or inlets) should be provided at the upper end of the ventilation system. These are usually vitrified stacks (see page 36 of March issue) connected to a peripheral duct around the wall, but they may also be formed in the concrete wall of the filter, using vitrified (see page 34, March issue) or sheet metal ducts set in the walls.

The vertical stacks or vents should be spaced on 6' to 10' centers around the entire wall of the filter and adequately capped. The cap should be designed to prevent direct discharge of the spray into the stack and still be low enough to avoid the distributor arm as it rotates.

Depth and **Dosing Rates**

High-rate filters as used in the biofiltration process have usually been of the shallow type, from 3.0 to 4.0 feet depth. The theory behind the shallow filter is that the volume of rock is more uniformly utilized at the high loadings, that better circulation of air (oxygen) is obtained and that there is less tendency to clogging of the interstices.

Some State Boards of Health have not yet fully accepted the shallow filter

for use in single-stage plants although many will consider them for two-stage plants. Therefore, before any final design is submitted, it is desirable to consult the State Board of Health. It is reasonable to assume that strictly on a volume comparison basis a shallow filter 3' to 4' deep can take more loading than a filter 6' or 8' deep.

Dosing rates on high rate filters are usually between 10 and 30 MGAD, but sometimes lower with very strong sewage, and higher with weak sewage; and also higher on the second stage of two-stage filters. In all cases, the dosing rate is based on the average 24-hour rate including recirculation, but maximum hourly dosing rates may be considerably higher, depending on plant design and flows. The minimum dosing rate may be established as desired by controlling recirculation, but dosing rate is not a critical design factor. If it is considerably above or below usual limits, the design should be checked. Dosing rates on the second stage of a two-stage filter may go as high as 35 or 40 MGAD but only with a weaker applied sewage.

Filter Media

Too much importance cannot be attached to uniformity of grading and freedom from undersize and dirt. Theoretically, the smaller the stone the greater the surface area available for bacterial films, but practical considera tions indicate that the larger sizes from 2" to 21/2" (or even larger) are me satisfactory. A smaller size has a great tendency toward ponding or clogging thus retarding the free circulation necessary oxygen. Any good hard store slag or gravel should be suitable long as it is cubical and uniform oblong or flat pieces are undesirable.

Special care in placing the stone important. If the under-drainage open ings will admit the smaller pieces, the selected larger pieces should be hand laid over these openings. Rock macontain dirt and chips which, if m screened out, will create permaner clogging conditions. Careful inspection is necessary to prevent this materia from being dumped on the bed; an once it is there, it is hard to remove Thorough washing of the stone is mediately before placing in the film is recommended; where this is in practical, an inspected wash at source should be substituted.

Poor results from some high-ra filter plants have been traced direct to poor stone grading and conseque inefficient utilization of the stone v ume or, more correctly, the surface an of the stone particles, because the i side is valueless.

On the second stage of two-star resulfilter, a smaller stone, $1\frac{1}{2}$ " to 2" sin is occasionally used. This is all rig right. providing these sizes are actually tained; but often where a smaller sto

ARMCRE FILTER BOTTOM BLOCKS BY

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Proved by performance in hundreds of sewage disposal plants, ARMCRE Filter Bottom Blocks meet all requirements for completely successful underdrain construction.

Special Features:

One of the easiest blocks to lay.

Made of highest quality de-aired Vitrified Shale and Fire Clay.

High compressive strength.

High resistance to acid or chemical action and deterioration.

Exceptional aeration and drainage features.

Easy to work over after laying.

More than 26% of top of each block is used for rectangular openings, permitting air to circulate freely and maintain ideal aerobic conditions. Entire inner surface of ducts is smooth. No solids accumulate in an ARMCRE system.

App. Dimensions and Weights

Full Block: 12" long, 10" wide, 5" high.

Ducts: Each 4" wide by 31/2" high; Crosssectional area per duct, 12.5 sq. in.

Top Openings: each 3" long by 1" wide.

Weight per Block: 20 pounds. Weight per square yard of floor: approx. 240.

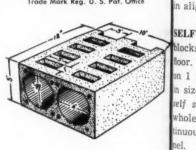
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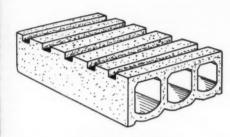
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Efficient Sewage Filter Block



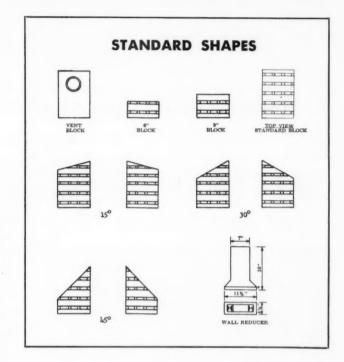
STANDARD BLOCK (Patented)

surface an The TRANSLOT patented filter block is especause the in cially designed to give better trickling filter results. With the standard fittings shown at the right, you can use TRANSLOT blocks on all types of trickling filter beds.

> EASY TO LAY. The basic size of TRANSLOT is 113/4" wide by 18" long by 41/4" deep. It has 3 longitudinal run-off ducts per block each 31/8" wide by 3" deep having circular inverts. Transverse slots across the top of the block provide penings into these ducts for the collection of downward flowing liquids and the upward pasage of air required by the filtering media. The inder side of each block has grooves running engthwise of the block which serve to hold it n alignment while laying.

> SELF-ALIGNING and SELF-SPACING. Six blocks are required per square yard of filter floor. The dimensions of the block permit laying on 1 foot centers. The block are very uniform in size and shape and being self aligning and self spacing they are rapidly laid. When the whole floor is covered, the block form a confinuous system of ducts to the collecting chan-

> AIDS RAPID FLOW. TRANSLOT block are made from vitrified clay and salt glazed. The



salt glazed walls of the ducts are very smooth, aiding rapid flow of liquids. Vitrified clay block make a permanent job as they are absolutely inert to the destructive action of the sewage.

STRONG BUT LIGHT WEIGHT. TRANSLOT block weighs only 190 lbs. per square yard, making it easy to handle and lay. In designing this block all excess weight was eliminated yet the design incorporates great strength. Actual tests have shown it to have a high factor of safety.

INSURES THOROUGH AERATION. The aperture area is of correct proportion to the gross area and properly spaced to insure thorough aeration of the filter media at the same time permitting water to trickle into the ducts.

Write for Engineering Bulletin

Cannelton Sewer Pipe Co. CANNELTON,

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Circulars

is specified for one filter, the tendency has been to use all undersize material remaining from the filter requiring the larger size, and because of improper regrading clogging has been inevitable. It is better to stick to the larger size for both primary and secondary filters.

Recirculation Pumps

These are usually constant speed, low-head pumps. Occasionally multispeed units are justified, but it is simpler to provide two or more standard pumps to vary the recirculation. On small plants a single pump for each recirculation station is usually sufficient. There are so many ways of hooking

up pumps that it is impossible to describe them in detail here. For the dual recirculation flowsheet (Fig. 2a) in a single-stage plant, the arrangement shown in Fig. 3 has had wide application.

A good recirculation pump may be used as a meter to indicate the amount of recirculation. In smaller plants, meters on recirculation lines are usually not justified but the operator can obtain flow data from the pump rating if each pump, as installed, is calibrated. This can often be done by measuring the drop, or rise in water level in one of the tanks when all other flow has been temporarily cut off.

Most engineers prefer the submerged

type of vertical pump for recirculation. These can be obtained in all sizes, are highly efficient, do not require dry wells and take up very little room. Recirculated flow is always a settled liquid, free from solids so strainers on the pump suctions can be omitted. Control of pumps may be by float in the wet well or manually. Pumps should always be equipped with a lowwater cut-off in case the sump runs dry.

Rotary Distributors

On any high-rate filter, dosing is continuous and the variation in feed to the distributor, or the ratio of maximum to minimum flow, is usually on the order of 2 to 1 and, occasionally 3 to 1. Siphons are unnecessary because of the relative uniformity of flow Head requirements to operate the distributor are largely a function of the head upon the orifice plus the loss in the arms and feed pipe. With a single set of orifices, to handle a flow variation of 3 to 1 requires a variation of 9 to 1 in the head on the orifices. For example, if the head on the orifices at minimum flow is 6", at maximum flow, this would be 9 times 6" or 4'-6". To this must be added the arm and feed pipe losses.

Some manufacturers overcome this by providing one set of orifices allow flows and two sets of orifices at high flows, or by using overflows or inverted siphons. The change over it entirely automatic and depends solely on the rate of flow. Such devices permit operating ratios as high as 3.5 to 1 with only 3.0 ft. of head between the stone and maximum water level in the center column.

With the high dosing rates, distributor arm sizes become quite large. Stand ard circular pipe of course is available for most any requirement. One manufacturer provides a fabricated sted tapered box arm, low in vertical dimensions, to keep the orifices as low as possible and conserve head. In this way arms equivalent to 16" diameter pipe are only 8" in vertical depth. A tapered arm provides better hydraulic conditions and more uniform distribution of flow.

Factors in Performance

Factors affecting biofilter performance include in addition to loading:
(1) strength of raw sewage in BOD;
(2) efficiency of primary settling; (3) recirculation ratio—the recirculate flow divided by the average raw sewage flow, usually designated as R;
(4) detention and overflow rates it settling; (6) removal of humus sludge from final tanks; (7) quality of digester supernatant liquor when returned to system. The BOD of the raw sewage obviously has a direct bearing on the performance of any biologic treatment. The biologic part of the

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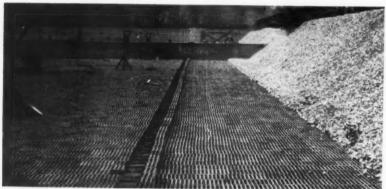
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Metro two-unit floor at Sewage Treatment Plant, Akron, Ohio

- ★ superior performance proved by many installations since 1926
- * area of channels is 64% of cross sectional filter area
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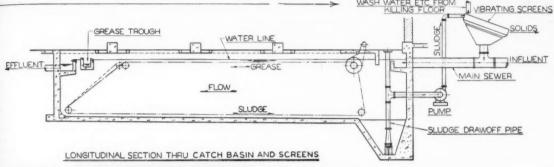
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Sizes, are RECOVERING VALUABLE GREASE Grown, Report of the street of the with LINK-BELT Screens and Collectors







large mid-west packing plant recovers valuable grease and solids, and avoids stream pollution by the use of the system diagramed above and illustrated at the left. Wash water from killing and dressing floors passes through Link-Belt liquid vibrating screens, removing coarser solids which go to tankage. The water is then pumped to the catch basins equipped with Link-Belt Straightline Collectors, where fat coming to the surface is skimmed off by the slow moving Collectors as they move along on the surface. Returning along the bottom of the basin, the same collectors carry the settled sludge to a hopper at the other end of the basin. The sludge is pumped to the vibrating screens for further solids removal.

By this means, valuable grease which would otherwise be lost, is recovered at a low cost, waste disposal is simplified and the load on the municipal sewage treatment plant lessened.

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Link-Belt products for sewage and industrial waste water treatment and water purification plants include -Straightline Sludge Collectors, Vibrating Screens, Mixers for Flocculation Tanks, Bar Screens, Tritor Screens, Straightline Grit Collectors and Washers, Heat Dryers, Straightline Scum Breakers for Digestion Tanks, Elevated Diffusers for degreasing, aeration and mixing of liquids, Non-Clogging Spray Nozzles, Traveling Water Intake Screens, Rotary Screens, Coal and Ashes Handling Machinery, Car Spotters and Haulage Systems, Shovels-Cranes-Draglines and a complete line of Elevating, Conveying and Power Transmission Equipment.



plant should be designed primarily on the basis of the raw BOD less that removed by sedimentation. However, biofilters have shown themselves capable of handling shock loads considerably above their design loads. For example, BOD tests at one municipal plant receiving occasional heavy industrial loads showed ability to handle maximum hourly loads 500% of the 24hour average without deterioration of the composited effluent. Biofilters are susceptible to toxic poisoning from certain trade wastes particularly those containing copper, chromium or silver, although their tolerance for these appears to be reasonable.

Primary settling of domestic sewage normally removes from 30 to 40% of the total BOD in the raw sewage. The more efficiently this section of the plant operates, the less work there is remaining for the biologic process to do.

Recirculation ratio, which has a direct bearing on the quality of effluent, is treated more fully under design data.

Detention periods and overflow rates in settling units determine their volume, area and efficiency. The overflow rate is the flow from the tank per 24 hours divided by the surface area of the tank and is usually expressed in gallons per square foot per 24 hours. For primary tanks, some agencies at present specify only detention while others specify only overflow rates. The National Re-

search Council, for example, reports that the Army Engineering Manual specified 2.5 hours detention for primary tanks based on average 24-hour flows. On the other hand, the Upper Mississippi group specify an overflow rate "not in excess of 1,200 gallons per square foot of surface area per 24 hours for the period of maximum dry weather flow of one hour duration." In most plants, it can be assumed that the maximum one-hour dry weather flow is 1.5 to 2.0 times the 24-hr. average which would result in an average 24-hour rate of 600 to 800 gallons per square foot.

Overflow rate in gal. per 24 hr. divided by 180 (which is 7.5x24) equals cubic foot per square foot per hour, or "feet per hour." The detention in hours multiplied by the rate in feet per hour gives depth in feet required. A simple formula which saves the calculation of actual tank volumes is as follows:

Gals. per day
Tank area in sq. ft. = 180 x depth in ft.
Detention in hours

From this formula, an overflow rate of 600 gallons will require a tank depth of 8.3 feet to provide a detention of 2.5 hours; a rate of 800 gallons requires a depth of 11 feet. Thus, it seems apparent that the two standards mentioned are in reasonable agreement as most tanks are within this range of depths.

For final tanks, the Army Engineering Manual specified an overflow rate of 800 gal. per day per sq. ft. based on average daily rate and a depth of 8 feet to 10 feet. The Upper Mississippi group states that the "overflow rate per square foot . . . per 24 hours shall not exceed 600 gallons at the maximum flow into the tank." With tank depths of 8 feet to 10 feet, and assuming the maximum flow is on a 24-hr. basis, and not hourly as specified for the primary, then the detention will vary between 2.5 and 3.0 hours.

It is believed that a rating of 800 gallons per square foot per 24 hours based on average 24-hour flow including recirculation should be applied to both primary and secondary tanks. A depth of 9.0 feet will provide 2.0 hours detention and a depth of 10 feet, 2.25 hours. A great many plants designed on this basis have produced excellent results. Both primary and secondary tanks can be identical, except for skimming facilities on the primary, and this design results in economy in smaller plants.

Secondary Sludge Removal

Continuous removal of the secondary or humus sludge from the final tank is important. It goes septic quickly and if allowed to remain in the tank more than a few hours, depletes the dissolved the

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ARMCRE Filter Bottom Blocks meet all requirements for an efficient underdrain system:

1—ADEQUATE AIR SUPPLY Area of ducts is 50% of cross-sectional area. 14 apertures in top total 38.5 sq. in. or over 24% of area. Large number and size of apertures allows air to pass from underdrains and circulate freely through filter media.

2—RAPID DISCHARGE Glazed surface and circular shape of ducts insures high velocity during low flow. Solids do not accumulate.

3-DUCTS CAN BE ALIGNED EXACTLY Center line scored on blocks so they can be laid to exact alignment to insure low frictional losses.

4—EASILY ACCESSIBLE Cross-section of ducts is big enough to permit quick inspection of underdrains without disturbing filter media.

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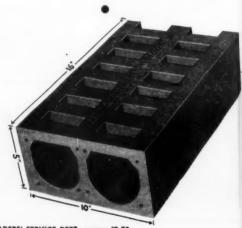
6—ECONOMY Weighing only 28 lbs. each, ARMCRE Blocks can be installed quickly by unskilled labor. Low height of 5" means less excavation.

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Jeffrey Equipped BIOFILTRATION SYSTEMS

(Patented)

Plants like these offer an economical solution of secondary treatment problems. Biofiltration has the following advantages:

- Lower first cost of filters, as depth is only 3 to 4 feet and volume of stone usually about 20% of that in standard low rate filters.
- Control of recirculation rates makes it possible to produce an effluent to meet varying requirements of the receiving water course.
- Automatic control of recirculation, makes possible less operating personnel than required in most secondary processes.
- Constant application to filter eliminates fly and odor nuisance.

Submit your problem to our sanitary engineers, who are qualified to give you economical solutions to your problem.

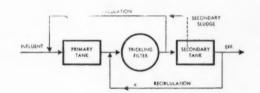
Typical Rotary Distributor used in Biofiltration Plants.

PERFORATED COVER BLOCKS

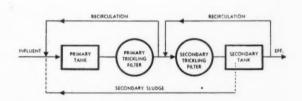
INSPECTION BOX

Single stage complete treatment plants (see drawing below) will give overall B.O.D. removals of better than 85%. Two stage complete treatment plants will give overall B.O.D. reductions of better than 90%.

Roughing filters, either with or without recirculation, can take enormous loadings with appreciable reduction in B.O.D. Such filters may be the solution to present overloaded secondary processes.



SINGLE STAGE PLANT



TWO STAGE PLANT



oxygen in the effluent. There are several ways of securing continuous sludge removal. One is to provide a gravity sludge line from the final or humus tank to the raw sewage wet well, controlling the sludge flow by weir box, float valve, nozzle or manually operated valve. Another is to run the flow by gravity to the primary recirculation pump suction well, if head is available. A third is to install a separate centrifugal humus sludge pump arranged to discharge into the primary clarifier feed. A fourth is to withdraw all of the recirculation flow for the primary circuit from the underflow or sludge line of the secondary clarifier and discharge it into the feed to the primary clarifier, as shown in Fig. 3. This may save an extra pump. It has not been found necessary to increase the size of the secondary clarifier to take care of this additional feed because it does not have any significant effect on detention but passes directly from tank inlet to sludge outlet. In all methods, the object is to return the humus sludge from the secondary to the primary for consolidation with the raw sludge before discharge to the digester.

A bad digester supernatant, loaded with solids, when returned to the raw sewage, will lower the efficiency of any sewage treatment plant. The best remedy is to have ample digestion capacity; otherwise a lagoon or extra sludge bed should be available. When measuring plant performance, the BOD

in the returned supernatant either should be included or the supernatant itself should be excluded from the system.

Overload and Performance

Biofilters are capable of overloading to an unusual degree. They will always effect some removal of BOD to an applied sewage within any rational load limits. They do not seem to break down completely or cease to function unless a highly toxic waste is applied or unless temperatures within the bed drop close to the freezing point. There are numerous examples of overloaded plants in military installations which yielded creditable effluents.

A biofilter plant can be designed to yield almost any type of effluent desired up to more than 90% removal. This is done by selection of flowsheet, filter loading and amount of recirculation. Performance data at specific plants are contained in the attached list of reference.

High nitrification and complete stability of the effluent, as commonly associated with low-rate filter effluents, are usually absent in high-rate filter effluents. However, the dissolved oxygen saturation is usually 50% or more, and with a low BOD, the need for or value of further nitrification is perhaps debatable.

A significant feature of biofilters is

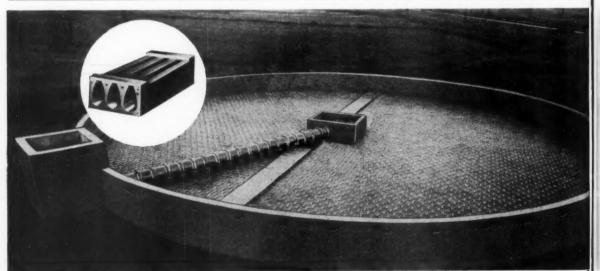
the absence of odors and the freedom from filter flies usually associated with low-rate filters. The continuous dosing assists in keeping down the fly population so that it seldom becomes a nuisance and generally goes unnoticed.

Post Treatment

Treatment by biofilters is usually adequate in itself but additional treatment may be utilized as low-rate filters, activated sludge or sand filters where it is necessary to provide a stable, highly nitrified, effluent or to "polish" it up. Chlorination is applicable and can be applied by any of the conventional methods, although care should be used in application to the filter proper to avoid an overdose thereby killing the biologic growth.

Design Data

To design a biofilter plant, three basic items must be known or carefully estimated: (1) average flow, with minimum and maximum variations; (2) BOD in the raw sewage in ppm. or pounds per day; and, (3) BOD required in the effluent in ppm. In addition, unusual factors such as volume and type of industrial wastes, both annual and seasonal (as cannery wastes) should be ascertained. Population load is usually known and it is customary to assume 0.17 pounds per capita per



NATCO UNIFILTER BLOCKS FOR TRICKLING FILTER BEDS

Above is one of two tanks, 90 ft. in diameter, installed at the LaChoy Food Products Division of Beatrice Creamery at Archbold, Ohio. Here Natco Unifilter Blocks of glazed, hard-burned clay, by reason of their light weight and single unit feature were rapidly and economically installed. Their great structural strength has resulted in low repair and maintenance costs. Write for literature.

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There's no ceiling on BIOFILTRATION PLANT SIZE

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These - and the advantages listed at the right - are but part of the story. We would welcome an opportunity to tell you more factually and completely why and how Biofiltration fits the big scale treatment picture.

ADVANTAGES OF DORR BIOFILTRATION FOR LARGE PLANTS

- (1) Uniform final effluent regardless of feed fluctuations or shock loads.
- (2) Filter loadings several times that of low rate filters.
- (3) Shallow filters.
- (4) Installed costs 10 to 25 percent less.
- (5) Operating costs 30 to 40 percent less.
- (6) Odor control assured for large cities where long sewers increase sewage
- (7) Industrial wastes, usually a factor in large cities, can be more easily treated.



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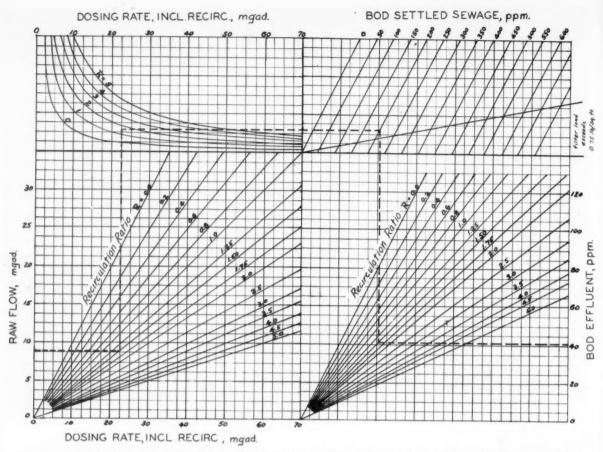


Fig. 4. Expected performance of single stage high rate filters based on Upper Mississippi group policy. Example (see text) shown in dotted lines.

day as the BOD contribution from the human population. Topography and head available usually dictate whether pumping of raw sewage is required. For a single-stage plant 12' to 15' of head through the plant is desirable; for a two-stage plant from 12' to 20'. Where these heads are not available, intermediate lift stations are needed and they can usually be designed to pump some portion of the recirculated flow. The required BOD in the effluent or degree of treatment is a matter to discuss with the State Department of Health which is the final authority.

Two methods of designing a biofilter plant are available, one the method set forth in the National Research Council report and the other that recommended by the Upper Mississippi group. The latter has been adopted by several State Boards of Health as a basis for tentative standards and is the one which will be used here.

The Upper Mississippi Sanitation Agreement, representing nine midwestern states, adopted a "Joint Statement of Policy" relating to high-rate filters in 1944. This statement sets forth limits of loading on filters as well as prescribing capacity in settling tanks. These data are based on extensive test work in the field and represent the simplest and, probably at this time, the best method.

The method adopted is based upon the use of area-not volume-of filters having 6' or greater stone depth as a measure of ability to remove BOD. The use of area instead of volume for filters of such depths is sound, because there are considerable performance data on low-rate filters which show that for depths between 6' and 10' or even 5' and 10' there is no measurable difference, within the limits of sampling and analytical errors, in the BOD of the effluent from the deeper filter compared to the shallower. Thus, even though surface area may not be the absolute factor, depth becomes a cancelable factor and for all practical purposes, area is an adequate yardstick for the engineer to use in designing the plant. Depth does enter into the problem, however, as will be shown later, but in a different manner.

Shallow biofilters, 3' to 4' deep are able to produce an effluent as low in BOD as the deeper filters. This is doubtless due to the greater biologic capacity per unit of volume for shallow filters compared to deeper ones.

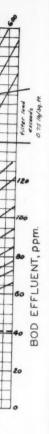
Application To Design

So much for comments on methods of measuring filter performance. The problem now is to apply these methods

to the practical solution of problems. Fig. 4 has been prepared to aid in the solution of the unknowns or variables in the design of single-stage plants. The constants used are slightly at variance with those in the Upper Mississippi group, but the solutions will be practically identical. The example shown in Fig. 4 illustrates the method of applying it but to add clarity a typical problem analysis is included as follows:

Assume the raw sewage flow at 4.0 mgd.; the raw BOD at 300 ppm or 10,000 lb/day; the BOD removal by primary settling at 33%, 3330 lb/day; and the desired effluent to be 45 ppm or less.

Solution: Assume the flowsheet shown in Fig. 2a is adopted; the settled BOD is 200 ppm (2/3 of 300). On the top right margin of Fig. 4, showing settled BOD values, locate 200 ppm, follow down this line to the intersection of the vertical lines from the recirculation values and observe the effluent obtained by varying the recirculation. Assume a value of R = 1.5 is selected giving an effluent of 41 ppm. Now on the left portion of the diagram, the dosing rate on the filter can be determined. By constantly noting the varying relation between recirculation and dosing rate any of a number of rates can be selected. Assume for this



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problem, a dosing rate of 22.5 mgad., including recirculation, is selected. On a raw sewage basis, the dosing rate will be $22.5 \div (1.5 + 1)$ or 9.0 mgad. The actual area of filters will be 0.45 acres $(4.0 \div 9.0)$ or 19,600 sq. ft. This area can be obtained with one 157-ft. diameter unit or two 112-ft. diameter units.

The depth of filter now can be selected either to suit a minimum State Board of Health requirement, or not to exceed a maximum loading per unit of volume of stone. Although area is used as the unit of measurement, it is good practice to keep loadings per unit of volume within certain limits for singlestage filters; 3,000 lbs. of settled BOD per af is probably adequate for this particular design because the desired effluent is not too critical. The 4.0 Mgd. of settled sewage at 200 ppm will total 6,670 lbs. of BOD per day. Filter volume required, therefore, will be $6,670 \div 3,000 = 2.23$ af. Since the area is 0.45 acre, a depth of $2.23 \div 0.45$ or 4.95, say 5.0, will satisfy the requirements for volume loading. The filters may therefore be either one 157-ft. dia. or two-112 ft. dia, units 5.0 ft. deep.

Both primary and secondary settling tanks remain to be designed. With the dual recirculation flowsheet Fig. 2a, it can be assumed that half of the recirculated flow or $0.75 \times 4.0 = 3.0$ mgd. is in each of the two circuits. Thus the average feed to the primary as well as to the secondary clarifier is the sum of the raw plus recirculated flow or an average of 7.0 Mgd. Assuming an overflow rate of 800 gal./sq. ft., the area of each will be 8,750 square feet. A water depth of 10 feet

will provide a detention of 2.25 hours. The primary and secondary units may each be identical units.

One equipment company provides a recirculation take-off launder or duct on the secondary clarifier. The launder is provided with a series of orifices submerged about 6" under the surface and designed to remove a specified quantity of settled effluent to be recirculated back to the filter feed. Removal of a portion of the tank effluent by this means reduces the overflow per foot of weir at the periphery of the tank and utilizes more efficiently the settling ability of the tank by removing overflow from more than one location.

Two-stage plants are designed by a modification of the method described for single stage. For Flowsheet Fig. 1c, allowance has to be made for omission of an intermediate settling tank. For Flowsheet Fig. 1d, the primary filter effluent is settled in the primary clarifier and the feed to both filters is identical, that is primary clarifier effluent, except that the secondary filter receives the recirculated flow from the secondary settling tank. Solution of problems involving these flowsheets have been worked out many times and are more or less standardized, so that a lengthy description would not be justified here.

Two-stage biofilters are usually more applicable to stronger sewages as they will yield a better effluent than single-stage with the same filter area and total recirculation. In the foregoing problem, it would be possible to reduce the BOD of the effluent to 25 or 30 ppm through the use of a two-stage plant with no increase in size of filters and very little change in the total recirculated flow.

REFERENCES TO BIOFILTERS

- Harry N. Jenks—"Shifting the Trickling Filter Into High"—California Sewage Works Association Journal, Vol. IX, Page 50.
- A. J. Fischer and R. B. Thompson—"The Biofiltration Process of Sewage Treatment"—Municipal Sanitation—November, 1939.
- 3. A. J. Fischer—"The Biofiltration System"—Water Works and Sewage—October, 1940.
- "Biofiltration for Sewage Treatment at Liberty, New York"—Public Works, July, 1940.
- Dorr Company Bulletin No. 7311—"The Biofiltration Process 1941."
- Rolf Eliassen—"Flexible Sewage Treatment for Army Camps"—Civil Engineering, December, 1941—Page 707.
- Frank Bachmann—"High Capacity Filtration: The Biofiltration System"—Sewage Works Journal—September, 1941— Page 895.
- A. J. Fischer—"Present Status of Biofiltration"—Waterworks and Sewage— October, 1942.
- Kessler & Norgaard "Sewage Treatment in Army Posts"—Sewage Works Journal—July, 1942, Page 757, and November, 1942, Page 1228.
- Graham Walton—"High Daily Rate Filter Performance"—Publication of Upper Mississippi River Basin Sanitation Agreement—March, 1943.
- W. A. Darby—"Recent Biofiltration Results"—Sewage Works Engineering—May, 1943—Page 246.
- National Research Council Report of Subcommittee—"Sewage Treatment at Military Installations"—Sewage Works Journal—September, 1946—Page 791.
- R. W. Simpson "Biofilter Operation at Keesler Field"—Mississippi Water and Sewage Works—September, 1946—Page 367.

BOOK REVIEWS

Sewerage and Sewage Treatment, 6th Edition, by Harold E. Babbitt, Professor of Sanitary Engineering, University of Illinois. 597 pages + problems + references + index, total 692 pp., 227 illus. John Wiley & Sons, Inc., N. Y. \$6.50.

The sixth edition of this well-known and widely used book is now available. References were made to this book in the article, On-the-Job Training of Sewerage Personnel (Public Works, Sept., 1946), through the kindness of Prof. Babbitt, and its present availability will aid in presenting the data contained therein. In this new edition, more stress has been laid on design problems, treatment methods and plant operation. Considerable space is given to some of the newer methods of treatment, as high-rate filters and contact aeration, and other methods of treatment are discussed fully and data concerning them brought up to date. In the field of sewer design, storm water runoff determination by the so-called rational method has been rewritten, as has the chapter on hydraulics.

It is exceedingly difficult to review

this book adequately in the amount of space available, much as the reviewer would like to do so for it is too complete and voluminous. We believe that every sanitary engineer whose duties touch on sewerage or industrial wastes should have a copy of his own for use and reference.

Going Abroad For Business. By E. B. Besselievre. Reinhold Publishing Corp., N. Y., 242 pp. \$4.

This is a new book by an old friend, and if you have any desire to conduct business in a foreign country, or if you wish to prepare yourself for possible residence abroad for business purposes, you will find it a most valuable guideso valuable indeed that you will probably spend a part of your traveling time committing it to memory. In a most readable and entertaining manner, the author prepares you for the subleties of alien psychology, for the pitfalls of local prejudice and protocol, and for the real pleasure to be derived from commercial and social contacts in foreign lands, where it must always be borne in mind that you are the foreigner.

Such details as the correct way to call on a government official, when and when not to invite him to dinner, what sort of domestic arrangements to maintain, the social activities of your wife—these and a host of similar matters are described at length. In addition, much valuable information is given on the technique of business transactions and liaison with the home office.

All in all, this book will probably do more in promoting good will in foreign business relations than any book that has yet appeared.

Standard Methods for the Examination of Water and Sewage. Ninth edition, 1944. Published by the American Public Health Ass'n., and the American Water Works Ass'n. 286 pp. \$4.

There is little that a reviewer can do with a book of this type. The laboratory worker will note the changes and additions and will approve them or complain. In appearance, the book is quite materially changed. It is set in two columns per page, making for easier reading. In addition it has been edited to a consistently high level of excellence by George E. Symons. Order your copy from the American Public Health Ass'n., New York, N. Y.

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with plastered walls, acoustical plaster ceilings, and linoleum floors. The toilet has ceramic tile floors and walls. The entire interior has a very pleasing appearance, and the acoustical treatment holds operating noises to a minimum.

The elimination of the steam equipment meant that a new source of heat had to be provided, so a boiler room and coal bin were constructed beneath the office and laboratory to furnish heat for the pumping station and future filter plant.

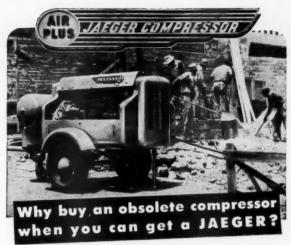
While the electrification work was being done, plans and specifications were prepared for the low service pump room, filter plant, and elevated tank. The low service pumping equipment will consist of two motor driven pumps of 700 gpm. and 1,050 gpm. capacity, and one gasoline engine driven pump of 1,400 gpm. capacity. Also in this room there will be a motor driven wash water pump of 3,500 gpm. capacity. Piping in the high service pump room is so arranged that it can readily be changed from direct pumping from the lake to pumping from the filter plant by the high service pumps and to direct pumping from the lake by the low service pumps.

The Filter Plant

The filter plant will have a rated capacity of 1.5 mgd. based on a filtering rate of 2 gpm. per square foot of filter area. There will be a rapid mixing basin with about 5 minutes' displacement; two coagulating basins of two compartments each with a total displacement period of 40 minutes; and two sedimentation basins with a total displacement period of 4 hours. The sedimentation basins will be of the around-theend type, as that type seemed to fit the layout the best. In order to obviate dead space in the corners of the basin a novel arrangement was worked out. A slotted baffle will be placed across the outgoing channel about two feet from the far end, forming a sort of cross channel. From the center of this channel, the water will be collected into a 16" pipe and carried across to the center of the return channel. Another slotted baffle will be placed across this return channel to disperse the water across the full channel width. At the inlet end of the outgoing channel and outlet end of the return channel similar baffles will be installed. It is believed that this arrangement will effectively prevent any short circuiting.

There will be three filters, each having a rated capacity of 0.5 mgd. These will have standard Wheeler bottoms, and will be controlled by operating tables through hydraulically operated valves. Both underwash and surface wash will be provided. Underwash water will be provided by the wash water pump in the low service pump room and surface wash water will be taken from the high service discharge header. Design washing rates are 30" rise per minute for underwash and 6" rise per minute for surface wash.

Disposal of wash water was a problem. Returning it to the lake was obviously undesirable, as the sediment would crease an unsightly condition in front of the plant and might get back to the intake. The only sewer close by was not deep enough and was too small to take the water at the full wash rate. To solve the problem, a dirty wash water storage tank was designed to hold the maximum quantity of water from any single filter washing operation. A 200 gpm. pump was provided which will pump the water from the





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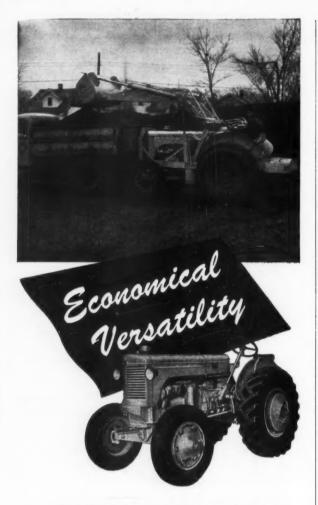
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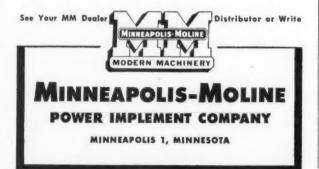


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storage tank to the sewer. This pump is of ample capacity to empty the tank in plenty of time for the washing of the next filter. An added advantage in this arrangement is the elimination of any direct connection between the wash water drain and the sewer. A filtered water storage reservoir with a capacity of 120,000 gallons will be provided, partly beneath the filters and the rest underground.

A chemical storage and feed room will be located above the sedimentation basins. There will be four dry feed machines, one for lime, one for alum, one for either lime or alum, and one for activated carbon. The carbon feed machine and carbon storage space will be in dust-tight rooms separate from the rest of the chemical equipment, and all electrical devices in these rooms will be loaded into the feeders by hand from a platform truck. Break-point chlorination will be provided for disinfection and taste and odor control. The chlorinators will be placed in a new room adjacent to the chemical room.

Plans and specifications have also been prepared for an elevated storage tank. The plans provide for a tank with a capacity of 300,000 gallons. This capacity may be increased to 500,000 gallons when the project goes ahead, as the mining companies are considering additional activities in the city and more storage may be needed. The tank will be located on a high knob close to the pumping station, and will be set at sufficient height so that it will ride on the distribution system.

The cost of the pumping station electrification was \$74,000. The estimated cost for the filter plant and elevated tank to complete the improvement project is approximately \$250,000. The pumping station has been operated with electrical power for a little over a year. The operating cost for 1946 was about \$11,500. The operating cost for 1944, the last full year under steam operation, was about \$32,000. Therefore, the electrification has resulted in a net saving to the city of over \$20,000, or about 65%.

The firm of Greeley and Hansen, of Chicago, Ill., has been the engineer for the city throughout the program, having made the original investigation and report in 1931 and prepared all the detailed plans and specifications. A part of the engineering cost was paid by the Michigan State Planning Commission. City officials exercising general supervision of the program were Alvin C. Hampton, Mayor; Arthur M. Anderson, Superintendent of Public Works, and L. F. Pearce, City Engineer.

Wetting Agents for Sterilizing Jute for Water Pipe Joints

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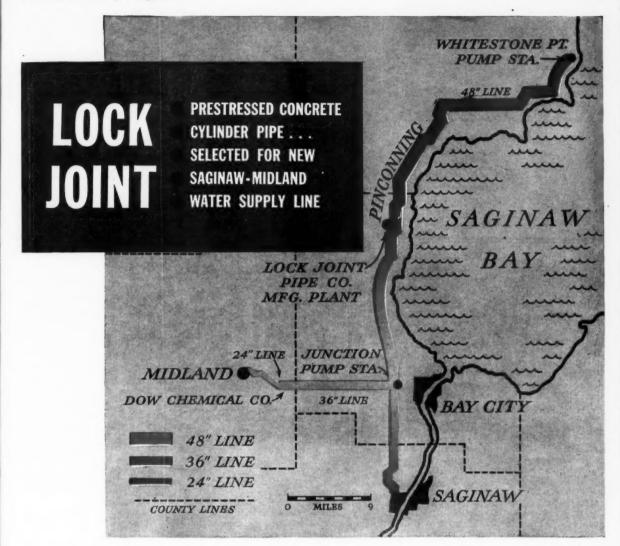
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PUBLIC WORKS DIGESTS

Sewerage

Water Supply

Highways and Airports

This section digests and briefs the important articles appearing in the periodicals that reached this office prior to the 15th of the previous month. Appended are Bibliographies of the principal articles, in which the articles in each periodical are numbered consecutively throughout the year, beginning with our January issue.

The letter and number at the end of each item refer to those used in the Bibliography. Numbers not found in the current Bibliography will be found in the one published the previous month.

The Sewerage Digest

A Highly Efficient Bio-Filtration Plant

In selecting a treatment plant for an army camp in New Zealand to handle 360,000 gpd from 5,000 men, biofiltration was preferred to other methods on the basis of cost, efficiency, power required, supervision required, flexibility, odors and flies. A two-stage plant with a recirculating ratio of 1.5 was adopted because of the small dilution of the effluent. The plant has shown high efficiency, 100% removal of suspended solids being obtained at times, and negative results for B. coli in all 20 cc samples, the District Office of Health reporting: "It appears that the effluent is up to our usual standard for drinking water, although I would not really recommend it for this purpose." BOD removal ranged from 60 to 80%; but this is not so important,

as the diluting stream reaches the ocean in less than one day's flow.

An interesting feature of the plant, but one which they do not recommend, is the use of the first clarifier to act as a balancing tank to even out a 100% daily variation in flow. This involved several difficulties and devices required to make the operation automatic.

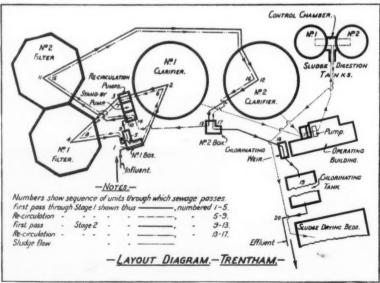
Two 45 ft. Door Sifeed clarifiers were used, with surface loading of 560 gal. per sq. ft. per day and detention period of 2.24 hr. The two filters were 40 ft. diameter, 3 ft. depth of stone, design loading 2.2 lb. applied BOD per cu. yd. and 30 mgad. Digestion is in two stages, the first heated to 80°. The tanks have Downer floating covers. At times the camp population varied greatly and suddenly, and the resulting change in volume of gas produced was pronounced but showed a time lag of

one week plus or minus 2 days. When sludge was added only once a day, the gas pressure increased during 1 to $1\frac{1}{2}$ hr., remained constant for a few hours, then decreased slowly; the pressure range being between 2 and $1\frac{1}{2}$ in. of water. H25

Heating Sludge

The heat requirements of digesting sludge vary at different stages of the process. Considerable heat is required to give the incoming sludge the desired temperature. As the digestion proceeds, the temperature must be maintained within a certain optimum range, but as it nears completion this is less important. Where pipes carrying hot water or steam are used, for heating the sludge, heat is transferred through the metal by conduction and through the sludge by conduction and convection. But attached to the pipe is a thin film of sludge through which transfer is solely by conduction; and there may be a scale on the pipe which inhibits transfer of heat. Therefore the transfer of heat from pipe to sludge is a function of the conductivity of the metal, the film, the scale and the sludge itself; and the quantity of heat required is a function of the specific heat of the sludge, which varies with its type, concentration and degree of digestion. The thermal conductivity of raw sludge is about 10% more than water and that of digested sludge about 25% more. The coefficient of the film is about 10% that for water. Sludge retains heat longer and to a higher degree than water. The scale which usually forms on the pipe further reduces the transfer of heat. Vertical pipes have the advantage of ease of removal for cleaning and less liability for solids to adhere to

Submerged gas burners give up practically all the heat of combustion to the sludge. Question is raised as to the danger of introducing an open



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flame into a digester. Burying the heating coils in the concrete floor and walls adds the resistivity of the concrete to the flow of heat. Heating by addition of hot water is not favored for several reasons. Use of steam to heat the daily additions of raw sludge requires 1 gal. per 10° temperature rise for each 110 gals. of sludge; the method is flexible and eliminates the sludge film coefficient of heat transfer.

External heat exchangers have a definite advantage over internal heating soils in the amount of heat that can be transferred to the sludge per sq. ft. of exchanger surface. Also they are accessible for cleaning and repair. And their use permits controlling the sludge temperature in any kind of a basin or tank. ^{C26} & ²⁷

Concentration of Activated Sludge

The writer has found it impracticable to concentrate activated sludge which has a high initial sludge index unless the sludge can be held sufficiently long for aerobic decomposition to take place, changing the physical composition of the sludge. Use of chlorine in concentration tanks may change the original physical characteristics in addition to keeping down odors, but it is difficult to operate such tanks without odor nuisance. Concentrations of activated sludge suitable for immediate discharge to digestion tanks can be obtained by proper methods of plant operation. The reciprocal of the sludge index times 100 is the maximum sludge concentration that can be expected from control of the activated sludge plant. C31

Treating Wool Scouring Wastes

After 5 years of research by Fields Point Manufacturing Corp. a new chemical process for treating wool scouring wastes has been developed, called the hypochlorite process. In this, calcium hypochlorite is added to the waste in a continuous-flow mixing and aerating unit, the amount of chlorine required being approximately equivalent to the amount of alkali used in the scouring operation. The effluent from this goes to one of three primary settling tanks which operate in rotation on a batch system. A clear supernatant is produced and discharged to stream or sewer. The sludge and scum are pumped to secondary settling tanks, where sulfuric acid is added until the pH has been reduced to between 4.0 and 5.00, mixing being provided by aeration. After 8 hr. detention, concentrated sludge liquor is produced and is dicharged to a pressure tank, where it is heated by steam to a temperature of 190° F and filter-pressed until 70% to 75% of the grease content is removed, leaving a filter cake with 15% moisture and 15% grease, which is used as fill without nuisance. This process yields a clear effluent, removing 100% of the suspended solids, more than 95% of the grease, and 80% to 90% of the BOD. However, the BOD of the effluent is still 600 to 700 ppm, but the



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chlorine demand has been met and there generally is 25 to 50 ppm of residual chlorine. $^{\text{C33}}$

Sludge Gas Utilization

All of the new treatment plants of New York City provide for sludge digestion. In the digestion of the combined primary and activated sludges, destruction of organic matter and concentration of solids reduces the volume 50%. Utilization of gas for ten years past at the Coney Island plant has satisfactorily lifted the sewage 40 ft. and operated the auxiliaries, while heat from the engine cooling water and exhaust engines has been adequate for

heating digestion tanks and buildings. At the Tallmans Island plant, 4 gas engines operate blowers and 4 others operate pumps against a 39 ft. head, accounting for 75% of the total power requirement and practically all of the heat.

New designs provide for larger tanks, up to 120 ft. diameter and 40 ft. side water depth, with multiple inlets, and positive circulation. In one plant, preheating of sludge before discharge to the digesters is called for. The digester gas averages 64.4% methane, plus or minus 2 to 3%. Its heat content is about 654 Btu; sulphur averages 2.4 gr. per 100 cu. ft.

A dual-fuel engine has been tested at Tallmans Island for over a year. It operates on the diesel cycle, which permits 25% greater power recovery from gaseous fuel than does the Otto cycle. and can operate on all fuel oil, or gas plus pilot oil, or any percentage of fuel oil and gas combined. It will pump 125 cu. ft. of air with the same quantity of gas required by a low-compression engine to pump 100 cu. ft. The author believed that, where a number of engines are needed in future plants, only as many dual fuel type will be used as are necessary for initial plant operation and continuity of operation; since, where there is abundance of gas, high efficiency is not important and the pilot oil would be an unnecessary expense. C28

Jointing Sewer Pipes

The Pacific Coast Clay Products Institute has conducted investigations and experiments on the tightness of joints in sewers of clay pipes, including bell-and-spigot, collar, push-together and other types, and all sorts of jointing materials, such as cold-setting cements, sulfur-base mixtures, elastomers, and bituminous or resinous materials. This report deals only with bell-and-spigot and collar type joints.

Cold-setting cements, including quicksetting varieties and expanding cements, are useful, especially in jointing large sewers, and make tight joints if carefully caulked. But with small pipes the inspection may be inadequate and workmanship careless; the rigidity of the joints may cause breakage of the pipes. Sulfur-base compounds also are rigid. Hot-poured bituminous or resinous compounds make flexible joints.

No materials were found that will adhere to salt glazing. "Since the prac-tice of salt glazing has nothing to recommend it and is already known to be undesirable for various other reasons, this additional indictment of it should cause no regrets." Experiments on penetration of roots into bituminous materials showed none which prevented such penetration. It was concluded that the ideal material should be too hard for roots to penetrate but not hard enough to crack on cooling, in addition to adhesion of at least 200 p.s.i. The nearest approach to this was furnished by a suitable coal-tar pitch mixed with a mineral filler, 3 parts of tar to 1 of filler. The hardness should be such that a 1 mm rod weighted to 60 grams should, in 24 hr. at 25° C., penetrate between 0.1 and 0.5 mm, or more in cold climates. C30

Comparison of Filter Media

The disposal works at Bishop Auckland, England, contain 16 percolating filters, the medium being 2" gravel in four of them, 2" slag in four, and 1" clinker in eight. All are 6 ft. deep and are dosed with 50 gal. per cu. yd. per day. The gravel filters have an efficiency of about 30% based on the oxygen absorption. But during the spring flushing periods they tend to flush themselves clean, when they be-

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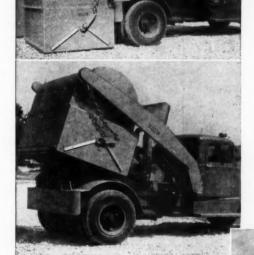
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have like new filters, the efficiency being low for approximately two months. The slag filters have an efficiency of 32%, which varies only 2% or 3% the whole year. There has never been any ponding and they teem with life. The clinker was 1" when placed in 1912 but now is approximately ½". The efficiency of the clinker filter is 33% to 35% and is very consistent. They pond slightly in winter.

There seems to be three distinct classes of life in the three sets of filters. In the gravel, snails are very numerous, no Achorutes, the usual worms, very few Psychoda. In the slag filters blue Achorutes are well established, also worms, and large numbers

of a small plumed black midge which travel as far as 600 ft. from the filters in large swarms. The life in the clinker filters is predominately worms, with fair numbers of grey Achorutes, a few Psychoda, and spiders.^{D17}

Effects of Beet Canning Wastes

At Geneva, N. Y. a primary plant with separate sludge digestion designed for 24,000 population satisfactorily treats the sewage of 20,300. But from September to January, beet canneries discharge into the sewers wastes with a population equivalent of about 33,000 persons and large amounts of grit and suspended solids. The sewage then has

an intense dark red color which persists throughout the treatment. There is about 29% increase in gas production, but its methane content is lower and more is required for keeping the digester at the desired temperature. The chlorine demand of the wastes varied from 220 to 460 ppm and that of the combined sewage and wastes from 5.5 to 20.8 ppm. The grit clogs the sludge lines and causes excessive wear in comminutor, pumps and digester mechanism; and city water under pressure has to be used to wash the digested sludge through the discharge lines onto the sludge beds. It is hoped that the cannery plant will provide improved screening and grit removal. C35

Sulfur Bacteria Cause Filter Pooling

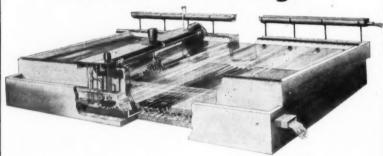
At Camp Kilmer, N. J., two biofilters 125 ft. diameter and 3 to 3.5 ft. deep gave trouble by pooling, which was found to be due to Beggiatoa. These oxidize sulfides, but as the water supply contains only 35 ppm of sulfates as SO₄ the source of the sulfur was a question. It was found that the two primary units contained cracks which admitted ground water with a high sulfur content. All the leaks were repaired and since then there has been no pooling trouble.

Efforts to remedy the pooling before the source of the sulfur was known were ineffectual. Finally the officials were advised to sterilize the beds, which they did by flooding them with clear water chlorinated to a 1 ppm residual and allowing this to stand for 48 hr. This killed practically all life in the filter, but left it with the interstices full of thick, heavy solids. These it was impossible to remove by flooding, flushing, or applying various chemicals. Then the beds were filled with sewage and the material digested anaerobically for 2 weeks. Following this, repeated flooding and flushing removed about 60% of the solids, and the beds were then placed in normal operation. After 2 weeks, natural sloughing began and became normal a few weeks later. C36

Bibliography of Sewerage Literature

- C Sewage Works Journal March
- Sewage Treatment at Toronto, By William Storrie. Pp. 149-160.
- 26. Evaluation of Methods of Heating Sludge. By Henry J. Miles. Pp. 161-166.
- Sludge. By Henry J. Miles. Pp. 161-166.
 Sludge Heating Methods. By Willem Rudolfs, A. M. Rawn, Vinton W. Bacon and Harvey F. Ludwig. Pp.167-169.
- Present Status of Sludge Gas Utilization. By Richard H. Gould. Pp. 170-177.
- Effect of Phosphates on Coagulation, Clarification and Sludge Volume. By Willem Rudolfs. Pp. 178-190.
- Sewer Pipe Jointing Research A Progress Report, By Harvey W. House and Richard Pomeroy, Pp. 191-201.
- Concentration of Activated Sludge. By Don E. Bloodgood, Pp. 203-206.
- 32. A Critical Review of the Literature of 1946 on Sewage and Waste Treatment and Stream Pollution. By Committee on Research. Federation of Sewage Works Associations. Pp. 207-247.

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Heating p. 161-166. By Willem W. Bacon 167-169.

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earch — A W. House 191-201. Sludge. By 206.

terature of Treatment Committee of Sewage 7-247. The Hypochlorite Process for Treatment of Wool Scouring Wastes and Recovery of Wool Grease. By Harry A. Faber. Pp. 248-257.

A. Fauer, Fp. 248-257.
Salaries for Sewage Treatment Plant Operators. Report of Committee of New England Sewage Works Ass'n. Pp. 259-264.

Effect of Beet Canning Wastes on Sewage Treatment Plant Operation. By Elvey A. Marshall. Pp. 266-269.

Sulfur Bacteria Cause Filter Pooling. By Clyde J. Shepherd. Pp. 273-275.

Operation Report, Urbana-Champaign (Ill.) Sanitary District, Pp. 275-277.

The Surveyor (England) March 7

Sewerage and Sewage Disposal in 1946. Pp. 131-133.

March 21

Sewerage and Sewage Disposal in 1946. Pp. 164-166.

Some Observations on the Operation of the Bishop Aukland Sewage Disposal Works. By J. R. Grieve. Pp. 167-168.

March 28

Purification of Waste Waters from Canneries. Pp. 173-174.

Water and Sewage Works

March

Gas Engine Maintenance and Opera-tion. By L. S. Kraus. Pp. 81-88. Treatment and Control Methods for Industrial Wastes. By L. F. Oeming. Pp. 105-110.

Miniature Industrial Waste Treatment Plant. By Roy F. Weston. Pp. 111-114. Some Thoughts on Controlling Indus-trial Wastes. By H. Malin. Pp. 115-116.

Sewage Works Engineering April

Bio-Filtration for New Zealand Army Camp. By John R. Browntree. Pp. 198-200, 226.

Pulp, Paper Industry Conducts Basic Research. Pp. 201-206, 238.

Industrial Wastes: Sewage = 4:1. By Marion L. Crist. Pp. 207-208.

Chemicals Total 70% of Sludge Filtra-tion Costs. Pp. 209-210.

Raw Sludge Pumping Practice. Pp.

Parellel Activated Sludge and Trickling Filters at Pontiac, Mich. By Thos. J. Doyle and Floyd Vermette. Pp. 219, 224.

Municipal Engineering (England) March 14

Biological Filtration. Discussion of Paper by B. A. Southgate. Pp. 121, 123. Economic Flocculation of Sewage Colloids. By John Finch and S. L. Wright. Pp. 128, 130, 137.

American City March

Dearborn, Mich. Plans Joint Garbage Disposal. Pp. 64-65.

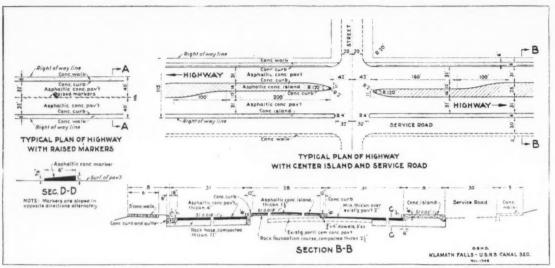
Public Works April

An English Experimental Sewage Treatment Installation. P. 21. A Health Service for the Armed Forces. By W. A. Hardenbergh. P. 30. Trickling Filters. By the Editors and Engineering Consultants. Pp. 37-38, 40-42.

X Bulletin, Reparticao De Aguas E Esgôtos (Brazil) November

Dados Sumários sôbre os esgótos da Cidade de S. Paulo, e Estação Experi-mental de Tratamento de Esgótos do Ipiranga. By J. P. Jesus Netto. Pp. 100-115.





Design details for 6th Ave. reconstruction, Klamath Falls.

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The Highway and Airport Digest

Soil-Cement Base in North Carolina

Last year over 50 miles of secondary roads in North Carolina were paved with a soil-cement base, covered with bituminous surface treatment or sand cement. This type was confined to unsurfaced secondary roads carrying not over 400 vehicles a day. Most jobs were 18 ft. of surface on a 19 ft. base, but some were 20 ft. on a 21 ft. base. The soil-cement was made 6" thick with 8 to 12% cement, in some cases 16%. The soils varied from heavy clay to sandy loam. The cement was all added in one application; in bags spread by hand by all but one contractor, who spread bulk cement by means of a mechanical spreader. Before placing the cement, the soil was scarified 6" deep with the scarifying attachment on a motorized grader or with a tractor-drawn scarifier. After the cement had been distributed it was mixed with the soil, most contractors using rotary tillers assisted by multiple-bottom gang plows and heavy cultivators. Meantime 15 to 30% of water was added. Two contractors used a 26-ton self-propelled mixer, which scarifies and mixes the material in a single passage; of four shafts at the rear, the first carries scarifying teeth, the second carries blades for blending the cement and soil; followed by 2 spray bars that add water, and these by two shafts that act as a pug mill. Sheepsfoot rollers compact the mixture except the top inch. Patrol graders shape the surface, a steel-toothed harrow loosens the top inch, and then this is compacted with pneumatic-tired rollers giving minimum compression of 325 lb. per inch width of tread. A spike drag eliminates surface irregularities during the last rolling, and after it a patrol grader blades off the high points. For curing, the surface is kept moist for 72 hr.

In giving the asphalt surface treatment, the base is primed with 0.2 to 0.25 gal. of tar, followed in about two days by 0.4 gal. of asphalt and 40 lb. of 1½"-¾" stone. After 10 days this is covered with 0.2 gal. of asphalt and 20 to 22 lb. of ¾"-No. 4 stone; followed by 0.2 gal. of asphalt, mixing with broom drags and rolling with 5-ton to 7-ton smooth steel-wheel rollers. The sand-asphalt surface was plant mixed and put down 1" thick with a self-propelled paver and rolled with an 8 to 10-ton smooth roller. E29

Widening a Suburban Highway

A 2-mile "ribbon" development has grown up along a highway east from Klamath Falls, Ore., containing about 12,000 population, and in morning and evening 4,000 cars per hour crowded the 20 ft. pavement. During the past year this has been widened to provide a 31 ft. travelway for each direction of traffic and 7½ ft. sidewalks, divided at critical traffic points by islands of maximum width of 28", reduced to 16 ft. for a length of 150 to 200 ft. for a deceleration lane for a speed of 40 mph to provide for left-hand turns. In addition, abutting owners have constructed at their own expense, on their own prop-

erty, 2800 lin. ft. of parallel service road 31 ft. wide with sidewalks beyond it. Where there is no island, separation is effected by a line of markers 10 ft. apart on the center line. These markers are of asphaltic concrete painted yellow, 6" wide, 29" long, 3%" high at one end and 1" at the other, skewed 36° from the center line. The widening base is 6" of keyed rock on 5" of compacted talus rock. On both new base and old concrete pavement is placed 4" of asphaltic concrete in two courses. The islands are of asphaltic concrete, 1½" thick, between curbs 6" high. Curbs and gutters are of air-entrained ready-mix concrete. N36

Reflectorized Road Signs

In Texas, all rural directional signs on state routes are reflectorized when built or repainted. Some districts used beads, others use reflectorized cloth. In using beads, the sign background is painted and lettering stenciled or put on with silk; and, after drying, it is coated with a thin layer of transparent varnish and covered with beads, then tilted to let the surplus beads drop off. Any good varnish will do. The beads have averaged 0.115 lb. per sq. ft. Field comparisons of beads with factory-reflectorized cloth have shown that the latter was recognizable as a U.S. Shield route marker about 200 ft. further than the beaded sign; but the numerals and arrow were visible 10 to 25 ft. earlier on the beaded signs. Curbs have been reflectorized satisfactorily by blowing beads onto fresh paint with compressed air, using a hand-held air nozzle in front of which a fine stream of beads is poured. N39

Snow Removal With Steam Pipes

Residents of Snake Hill. Belmont. Mass., keep a steep road leading to their residences passable all winter by means of two 1½" iron pipes laid 5" under the black-top surface of each wheel track for a distance of 750 ft. and pumping through them water heated to 140° by an oil heater located half way up the hill. The cost is estimated at \$20 a year for each householder benefited (number not stated). A resident of Winchester heats his driveway 12 ft. wide by 75 ft. long similarly, heating the water by an oil heater in the house, which is started automatically when snow accumulates on a pan. E30

Construction

Among many contributions to an airport session at the annual convention of the ARBA, a few were excerpted in this article, and a few of these are abstracted

All airports for use by heavy aircraft need super-compaction of upper base courses, and also of the subgrade where the combined base and pavement thickness can be less than 4 or 5 ft. For use by lighter planes only, supercompaction for 2 or 3 ft. below the top of the pavement may be sufficient.

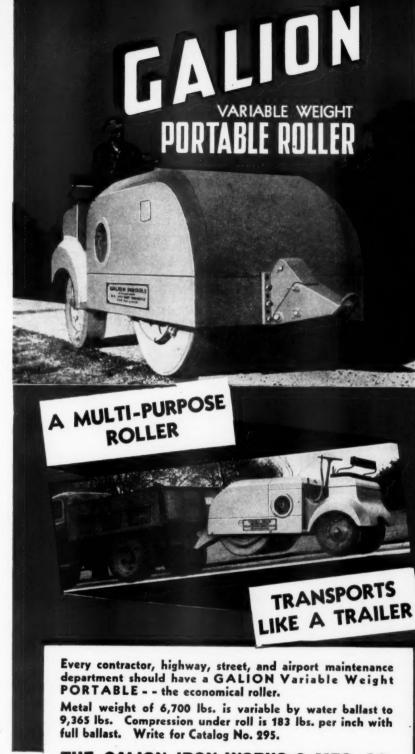
CBR method of evaluating subgrade support for flexible pavements "is still definitely the best practical and proved means" in the opinion of the Soil Mechanics Section, U. S. War Dept. The shearing strength of the soil at a low percentage of strain is the controlling factor in determination of subgrade sup-

Combined drainage and subdrainage in one system is very practical in many cases, if properly designed and installed. Two types are used successfully; in one the pipeline is installed at the edge of the pavement and a porous backfill is carried up to the finished grade; in the other, the paved surface is provided with gutters inside the edges of the paved section, under which the pipe line is laid, with grate-top catch basins. The most important feature in either system is the porous backfill.

Storm drains should be placed as shallow as possible in order to save excavation and obtain good grade to the outfall. The depth of subdrainage lines should be determined by the free water table elevations, water bearing strata, and soil permeability. In many cases the subdrains may be too low to discharge into the storm sewers.

The only expansion joints needed are at intersections of runways, taxiways and aprons, or where the pavement abuts on a building. Contraction joints average 20 ft. spacing for stone aggregate, blowing age 20 ft. spacing compressed 15 ft. for gravel.

Air-entrained concrete is decidedly



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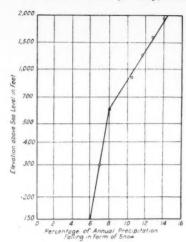
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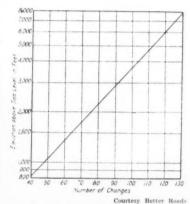
t. earlier on ve been redesirable in freezing climates; has many advantages in all.

Dense-graded hot-mix tar pavements do not readily absorb petroleum drippings. Satisfactory pavements have been made with asphalt, using surface treatment, mix-in-place, penetration macadam, and plant-mix. The last two are recommended for heavy-duty airports.^{1,7}

Effect of Climate On Highways

"In roadbuilding as well as in a variety of other engineering tasks, climate is one of the basic elements that should be considered in the earliest stages of planning. If that is done, it will be an important step toward better, weather-adapted roads." Information collected by the Weather Bureau permits estimates, for any given location, of snowfalls, snow drifting, sand drifting, frost penetration and duration, frost heaving, and probable volume of floods in streams. These vary by geographical location and by attitude; also by local topography. Even filling in a dip in a road may not only improve visibility but may even prevent formation of treacherous ice patches and ground fog. In eastern and central Pennsylvania a road more than 600 ft, above sea level will receive much more snow than those be-





Number of changes through frost point in re-

low that elevation. Most frost damage to roads is done by alternate freezing and thawing, and the number of such alternations increases with the altitude; and in some places the intensity of such changes varies with the color of the road surface. Drifting of snow varies with the combined elements of snow cover, temperature and wind velocity. R8

Equipment For Soft Ground

The Engineer Board, U. S. Army, testing the performance of heavy trucks and construction equipment on soft ground, have not yet found an all-purpose track or tire that will give ideal off-road service and also perform well at traffic speeds on highways. Among the ideas tested are tracks 31" wide on a Caterpillar to bulldoze heavy mud; tractors fitted with 60" hard-wood track extensions, which sank 30" in soft, highly adhesive mud; rubber-incased tire chains; over-size cleated treads. 87

Equipment on Virginia Superhighway

In a 1,200,000 cu. yd. grading job on this road, the contractor used a Euclid loader for most of the work, filling high-speed wagons. This was



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preceded by a ripper. A patrol grader sloped banks and maintained haul roads. Bulldozers spread dumped material in 8" layers for compaction by a two-gang sheepsfoot. For short cuts or with small vardage, 12-yd. carrying scrapers were used. 8

Bibliography of Highway and Aiport Literature

- Engineering News-Record March 20
- Roads to Riches in Venezuela. By Edward J. Cleary. Pp. 80-84.
- Gravimetric Analysis of Sand. By L. J. Ehly, P. 106.

April 3

Secondary Roads Paved with Soil-Cement, Pp. 64-67.

April 10

Steam Pipes Keep Steep Road Clear of Snow and Ice. P. 16.

Civil Engineering April

- Standards for Adequate California Highway Systems Stress Safety of Op-eration. By G. Donald Kennedy. Pp. 92-26
- Airport Construction, Operation and Maintenance. Pp. 31-34.

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The Importance of Highway Lighting. By H. O. Davies. Pp. 18-19.

The London Airport

At the London, Eng., airport three of the seven runways, scheduled to be completed before 1950, are already finished. The completed runways are 300 ft. wide; one is 9,000 ft. long and the other two are 6,000 ft. long. During the next phase of construction



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the longest one will be extended to 12,000 ft. and one 6,000 ft. runway to 9,000 ft. In addition four more runways will be constructed; two will be 6,000 ft. long by 200 ft. wide and the remaining two 300 ft. wide by 6,000 ft. and 9,500 ft. long respectively. The runways are designed to take aircraft of 360,000-lb. gross weight. For surface run-off, dished lanes were constructed on either side of the runways. Catchpits are at 175-ft. intervals and are connected by feeder drains to the collector drains which have a diameter of up to 48 in. and run parallel to the runways. The main outfall consists of four 54-in, concrete pipes, laid side by side, discharging via an oil trap to a gravel pit and thence to an adjacent river. Owing to the level nature of the site, drains have been designed with slopes of as little as 1 in 3,000 and hence extreme accuracy is necessary in laying them. Road Abstracts, based on articles in a number of Bristish journals.

Motor Graders on Weld County's 6000-Mile Road System

Road building and maintenance is a sizable undertaking in Weld County, Colorado, which, with its 4022 square miles, is one of the largest counties in the country. The county is served by some 6000 miles of roads, 400 miles of which have been oiled and 75 percent graveled. To facilitate road work, the



Galion grader on Weld Co. roads

county is divided into three highway districts. Motor graders, such as the Model 102 Galion with an International Diesel UD-14 power unit, are necessary to meet the wide-flung demands for maintenance and construction.

In building up to grade preparatory to graveling, as shown in the illustration, the grader was started at the edge of the road on each side until there was a vertical cut of 5 feet and a borrow pit 12 feet wide. The dirt from this borrow pit was worked toward the middle to build a roadway 3 feet above the borrow pit.

Rust Prevention for Highway Signs

Wartime experience of the Army and Navy in protecting equipment against rust and corrosion is being used by state highway departments. Seven states —Alabama, Iowa, Kentucky, Massachusetts, Michigan, Minnesota, and Missouri—are using a priming paint containing zinc yellow pigment for protection against rust on both new and existing steel highway signs. Zinc yellow is a pigment that was used in paints on Navy ships, Army jeeps, trucks, tanks and planes, for an undercoat next to bare steel and aluminum. Primers formulated with this pigment dry rapidly and provide a hard, adherent surface for the finish coat.

Where there is continuous exposure to the weather, du Pont states, the use of a zinc yellow priming coat on a clean metal surface affords many additional years of rust-free life. The highway signs of the seven states are painted with primers in which an average of 27% of the pigment is zinc yellow.

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Yale Traffic Engineering Fellowships

Ten graduate fellowships in traffic engineering have been announced by the Bureau of Highway Traffic, Yale University, New Haven, Conn. These amount to \$1400 each and provide for a full year of study beginning Sept. 22, 1947. They are open to men with a degree from an accredited college in some branch of engineering. Preference will be given to applicants now employed in street and highway engineering work who obtain a leave of absence to return to their present employer. Closing date for applications is June 15.

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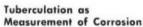




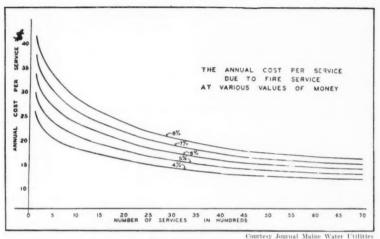
The Waterworks Digest

Annual Cost Of Fire Service

This consists of interest, depreciation and cost of operation and maintenance. Interest is probably between 4% and 8%. Depreciation for that part of the plant necessary for fire protection, mostly pipes, is taken at 1%. The average operating and maintenance cost of 18 Maine works was \$11 per service (services being taken as the unit for cost comparison), all except a few lying between \$9 and \$14. From this should be deducted cost of source of supply, purification, meters, services, accounting and billing, shop operating for services and meters, maintenance of mains under 6", half the pumping and a share of the overhead. With these eliminated, the average operating and maintenance cost of fire service of these 18 plants was \$6 per service. Or an approximation can be obtained by using a diagram which gives the average annual cost per service due to fire service, for communities with various numbers of services, and for various interest rates between 4% and 8%. V3



In studying the extent of corrosion in the mains in San Francisco and the effect of corrective treatments, it was assumed that the amount of tuberculation is reflected directly in the increased head necessary to pass a given amount of



Costs for fire service.

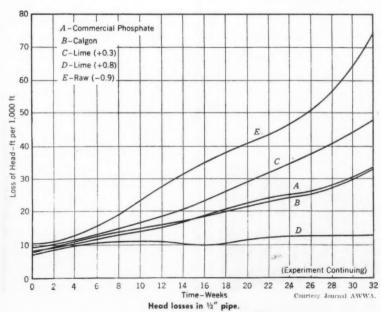
water through a pipe. Water was passed at 0.5 gpm, continuously for periods up to 40 weeks, through ½" and ¾" pipes; the water passed through one pipe being raw, while that passing through four others was treated with commercial phosphate, Calgon, and lime of two different saturations. From these studies the following observations were made: The decrease in the flow coefficient C with time compares favorably with Langelier's saturation index. The rate of tuberculation when using I ppm of sodium hexametaphosphate, is the same

whether the pH be 6.1 or 7.7. Sodium pyrophosphate and hexametaphosphate in concentrations of 1 ppm gave comparable protection as corrosion inhibitors. Maintenance of a positive saturation index of + 0.7 would give a high degree of protection.

The increasing loss of head in the several pipes for a period of 32 weeks, using water from one of the city's two sources of supply, is shown by the illustration. A45

Erosion Around Wash Water Orifices

Milwaukee in 1939 installed a filter surface-wash system using pipes with 1/8" orifices 8" apart. Four years later it was found that about 25% of the orifices had eroded areas around them about the size of a dime, and later observations showed that the erosion was growing deeper. Experiments were made which showed definitely that sand is sucked into the orifices by the vacuum created by the discharging jets, which causes a whirling action which scours out a hole much like that which a spherically shaped countersinker would. Plugs of babbitt metal, drilled with 1/8" holes, were inserted in the eroded holes, but they were eroded on the end in the same way as the orifices. Nozzles then were inserted in the pipe at the orifices, and there was no more erosion of the pipe. However, there was wear at the tips of the nozzles, except one style made by the Alemite Co., and 120,000 of these were purchased-for 32 filters, each with 64 laterals, each lateral containing 55 orifices. They are expected to last 20 years. A47



Titration Measurement Of Chlorine Residuals

The author has developed, since 1943, a method for measuring free available chlorine by orthotolidine titration, requiring only the simplest of laboratory volumetric apparatus and reagents. A simple "eyedropper kit" provides adequate accuracy for most field chlorination tests, and is particularly valuable for measuring high chlorine residuals used in such chlorination practices as disinfection of water mains, wells and reservoirs. The chemicals required are dilute hydrochloric acid and standard orthotolidine solution. It is applicable at any temperature ordinarily encountered

in chlorination of water. It can be used with a high degree of confidence with waters containing nitrites, iron or manganese. It serves as a satisfactory control test for free residual chlorination of many types of water. True free residuals can be measured with a higher degree of precision than by the ordinary colorimetric tests. A44

Free Residual Chlorination

Free residual chlorination-the application of chlorine in amounts sufficient to provide an uncombined surplus of chlorine in the water-results in superior bacteridical action,

improved taste, odor and color removal, eliminates after-growths in the distribution system, and inactivates the virus of poliomyelitis. It is especially successful in small plants. Its use is superior to that of chlorine-ammonia. It oxidizes organic matter in settling basins, extends filter runs, eliminates aftergrowths in distribution systems, can be carried effectively throughout water systems. It generally eliminates continuous need for carbon and ammonia; thus reducing cost although 11/2 to 5 times as much chlorine is used. However, it is not a complete remedy for phenol-contaminated waters — chlorine dioxide is preferable. E11

Increasing **Treatment Plant Capacity**

Yuma, Ariz., takes its supply from the Colorado river, which had a silt content of 1500 to 55 ppm, and the original treatment (in 1906) was sedimentation only. By 1928 there were four sedimentation basins with a combined capacity of 2,600,000 gallons. By 1943 consumption had reached 4 mgd, and turbidity after settling for 24 hr. was still 37 ppm and the filters clogged

Experiments with a view to decreasing turbidity showed that best results in Dhio, sedimentation were obtained by using 17 ppm of aluminum sulfate, flocculating for 15 minutes, followed by one hour of sedimentation, which reduced the turbidity to 9 ppm, and the plant was remodeled to use this method. One of the old sedimentation basins was used for presedimentation; another received a flash mixer and four rows of flocculators; the third was used for sedimentation after flocculation.

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Thus, at a cost of about \$20,000, a settling, filtering and treatment plant which, ten years ago, had apparently reached the limit of its capacity, has had that capacity increased 21/2 times. A48

Waterproofing Concrete Structures

Concrete can be waterproofed either before or after it is put into service. The former is more effective and cheaper. It can be performed by integral or applied methods. Integral waterproofing is achieved by mixing some substance into the concrete that increases its density or is water repellent. Air entraining is a successful method of obtaining impermeability. Abundant cement is the most satisfactory ingredient. Applied waterproofing is made of pore fillers, plasters, and membranes; the first two are used more for damp-proofing than for impermeability. Membranes are built up of fabric or paper and bituminous

For waterproofing after service, gunite is widely used. Cement grout may be applied internally by forcing it into cavities by means of pipes, sometimes with Bentonite as an admixture. Cement-like products offered for sealing cracks and surfaces are more or less limited in their applicability and require



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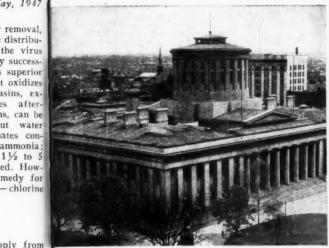
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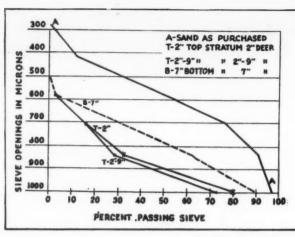


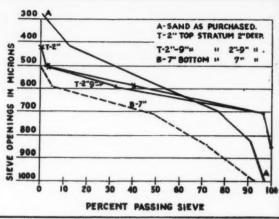
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Sieve analysis of filter sand before and after cleaning.

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very painstaking work in their use. Several membranous types which are applied hot have given satisfactory results when applied by an experienced contractor.

Before deciding on repairs, determine the full extent of the damage, probable future recurrence, type of repair necessary, material best suited to the repairs, precautions required in preparing the surface to be treated, application procedures, and select an experienced contractor or application personnel. A40

Filter Sand Incrustants

In 1940 the St. Paul, Minn., treatment plant changed from alum coagulation to lime-soda softening, at the same time constructing several new filters. In 1945 a study was made of incrustants which had formed on the filter sand of both the new beds and also those which had been in use since 1923. It was found that lime, vegetable matter, micro-organisms and the residue of the

coagulant combine to build up the incrustant on the sand particles. In inspecting the sand, samples were taken from the upper two inches, from the stratum 2" to 9" deep, and from that 7" above the bottom; and mechanical analyses were made before and after removing the incrustant with acid, and compared with similar sand that had not been used. Two kinds of sand had been used in constructing the beds—Red Wing and Eau Claire. In the beds using the former, the surface strata had been



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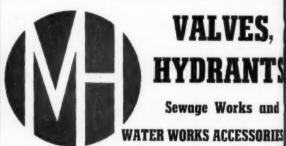
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May, 1947

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made coarse by incrustants, but were much finer after cleaning; while there was little change in the bottom stratum either before or after cleaning. The uniformity coefficient had been changed by the incrustants from the original 1.62 to 1.42 at the top and 1.29 at the bottom; which the cleaning changed to 1.21 at the top and 1.28 at the bottom. F17

Stream Pollution In New England

The State Sanitary Engineers of the six New England states are cooperating toward obtaining an agreed classification of streams in accordance with the relative abatement of pollution of them that seems necessary, and are endeavoring to obtain such abatement in their respective states. These engineers reported, at a meeting of the New England Water Works Ass'n, the progress that had been made.

Maine created a State Sanitary Water Board in 1941, and in 1945 passed a law requiring all industries established thereafter to take out a license before discharging industrial wastes into the waterways of the state, but existing industries could continue to do so. The Water Board surveys and classifies the streams and endeavors to persuade cities and industries to abate their share of the pollution. There is need of stronger legislation. B9

New Hampshire has recently appointed a Water Pollution Board of ten men representing all the interests-industry, health, recreation, fish, planning and others, to study the problem, confer with officials of neighboring states and report to the governor. Every body of water having an area of more than 20 acres is the property of the state and under state control. B10

Vermont's laws to control stream pollution are very inadequate, but fortunately no streams from which public water supplies are taken receive sewage above the intake. Each of the 12 major river basins in the state is being organized so that pollution control and sewage treatment can be planned for the particular needs of each basin. A state legislative committee was formed to draft laws to control pollution, the first being a sewer service charge enabling act. Sewage treatment plants now serve only 6% of the sewered population or 2.9% of the total population. B11

The Massachusetts Dept. of Public Health since .1945 has had mandatory powers in matters of stream pollution control. Its regulations provide that no sewage, human excrement or domestic waste waters, putrescible matters, poisonous or other wastes shall be discharged into any stream or other body of water in a manner injurious to public health or tending to create a nuisance unless the Dept. of Public Health approves. Bacterial content of the streams or other bodies of water are considered to be of first importance. B13

Rhode Island in 1904 adopted laws to prevent pollution of sources of water supply. In 1939 administration of the law was given to the Division of Sanitary Engineering. At present the sewage of nearly 90% of the sewered population receives treatment, and 10% of the industrial wastes that do not reach the sewers. A state law is needed permitting municipalities to assess sewer charges to finance treatment plants; also creation of treatment districts by the legislature. B12

Bibliography of Waterworks Literature

- A Journal, American Water Works Ass'n March
- Selection of Customer Service Meters. By Samuel F. Newkirk, Jr. Pp. 195-199. Contemporary Chlorination Practices. By Harry A. Faber. Pp. 200-208.

- Ortho-tolidine Titration Procedure for Measuring Chlorine Residuals. By C. H. Connell. Pp. 209-219.
 Turberculation Measurement as an Index of Corrosion and Corrosion Control. By Edwin W. Barbee. Pp. 220-230.
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 New Filtration Plant at Midland, Pa. By H. F. Holloway. Pp. 361-368.
 Ground Water Studies in Wisconsin. By F. C. Foley, W. J. Drescher and G. E. Hendrickson. Pp. 369-379.
 Well Cleaning and Rehabilitation. By H. Cleaning and Rehabilitation. By H. C. Wenrick. Pp. 380-384.
 Radio Communication for Water Works. By Raymond G. Ridgely. P. 384.

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Toronto Waterworks Extensions. By William Storrie. Pp. 1-33. Reforestation on the Quabbin Reser-voir Project. By Russell Snow. Pp. 34-

Water Treatment Plants. By E. W. Campbell. Pp. 50-58.
 Problems and Progress in Handling Stream Pollution Abatement in Connecticut. By Warren J. Scott. Pp. 59-69.

necticut. By Waller Scale Sanitary Water Board in Maine. By J. Elliott Hale. Pp. 64-67. Problems and Progress in Handling Stream Pollution Abatement in New Hampshire. By Leonard W. Trager. Pp. 68-73. Pp. bland and Progress in Handling

Hampshire, By Leonard W. Trager. Pp. 68-73. and Progress in Handling Stream Pollution Abatement in Ver-mont. By Edward L. Tracey. Pp. 74-76. Problems and Progress in Handling Stream Pollution Abatement in Rhode Island. By Walter J. Shea. Pp. 77-79. Problems and Progress in Handling Stream Pollution Abatement in Mas-sachusetts. By Arthur D. Weston. Pp. 80-87.

Policy Choices in Employer-Employee Relations. By Royal Parkinson. Pp. 88-96.
 Cathodic Protection of Steel Tanks and Standpipes. Committee Progress Re-port. Pp. 97-104.

The Surveyor (England) D March 7

Corrosion of Buried Pipes. P. 139.

Engineering News-Record March 7

Free Residual Chlorination Improves Water Quality. P. 96. April 3

Pneumatic Concrete Placers Speed Lining of Small Tunnels. Pp. 68-70. Baffled Basins Improve Sedimentation. By Edward S. Hopkins. Pp. 80-81.

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This Hired Man Works Cheaply and Efficiently. By M. H. Strong, Pp. 292-294, 318. Your Fublic is Reasonable but Wishes to be Informed. By Floyd L. Vermette. F. 298.

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Cleaning Filter Sand with Sulphur Dioxide. By Clyde F. Angle. Pp. 92-94.
 Office Operation in a Small Water Co. By C. M. Hartman. Pp. 95-96.
 Operation of Well Supplies. By R. W. Simpson. Pp. 97-99.

Selection of Water Meters for Customer Service. By S. F. Newkirk, Jr. Pp. 100-101.

American City March

Asheboro, N. C. Builds New Dam. Pp.

Mattoon, Ill. Unifies Water Supply. By John A. Goetz and R. D. Wilson. Pp. 88-89.

How to Reduce Main Sterilization Work, P. 97.

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How to Estimate Water Demands and Pipe Sizes for Housing Units. Pp. 22-

24. Electronic Coagulation. By Fred E. Stuart, Jr. Pp. 27, 36. Cost of Water Pipe Trenching and Backfilling in 1946. By Charles R. Moore. P. 31. Public Use of Reservoirs—An English View. Pp. 32-33.

V Journal, Maine Water Utilities Ass'n March

March
Should Utilities Own All Water Meters and Maintain Them? By George S. Wescott. Pp. 24-26.
The Annual Cost of Fire Service. By Harry U. Fuller. Pp. 27-31.
Cost of Trenching and Backfilling in 1944. By Chas. R. Moore. Pp. 32-33.
Extensions During 1946. By Fred J. Reny. Pp. 34-37.

Bulletin Reparticao De Aguas E Esgotos (Brazil) November

Abastecimento de Agua da Cidade de S. Paulo, Sua solucão, By Plinio Pen-teado Whitaker. Pp. 3-99. Determinação do pH otimo de flocu-lação e dosagem mínima de coagu-lantes. By Alvaro Cunha. Pp. 117-125.

Contractors Record (England)

March 26
Ionized Silver for Flocculation and Sterilization of Water. By W. J. Marshall. Pp. 20-21.

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CO. LINOIS

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PUBLIC WORKS Equipment News

3-Speed Power Unit Simplifies Pipe and Sewer Cleaning

Easy portability, reversible electric operation, greater speed, economy and operator safety are features of the "Flexi-Cleaner" made by the Flexible Sewer-Rod Equipment Co., 9059 Venice



Flexi-Cleaner for clogged pipes.

Blvd., Los Angeles 54, Calif. This cleaner is designed to handle "Flexible" steel or coiled cleaning rods; or the rods may be turned manually as well. Couplings on both types of rods are interchangeable, so coiled rods may be joined to steel rods.

A Revolutionary Method of Water Conditioning

The Thornberry Non-Chemical Liquid Conditioner consists of a steel cylinder containing thousands of small, spherical, specially-treated silicate "haffles" 3%" in diameter. Friction of the water passing over and around the baffles increases their positive ionic charge, and gives them an increased ability to attract ionized particles from the water.

The reaction caused by the many sudden change-of-direction of the water results in certain mineral salts and impurities precipitating out of the water to the bottom of the cylinder, and onto the baffles themselves, while the baffles collect additional crystalline formation through the process of specific adsorp-

As a result, the physical characteristics of the particles are so altered that they do not form scale, but are removed by normal blow-downs.

The only attention required by the conditioner is an occasional flushing operation, which takes approximately five minutes. This is done by closing the outlet valve and opening the flush valve

while rotating the cylinder. When the flush runs clear the flush valve is closed, the outlet valve opened and the conditioner is again in operation.

There is no maintenance cost; no parts to replace; and no recharging of materials. It is applicable to municipal water supply where scale forms in water pipe. Write Non-Chemical Liquid Conditioner, Inc., Barnesville, Ohio, for information and booklet describing the method

Odorless Cleaner for Septic Tanks— A Needed Health Service

The Gorman-Rupp Company, Mansfield, Ohio, has announced an odorless sanitary cleaner which promises to be of great service to those living outside city sewer lines and to operators who have had to use makeshift equipment and unsanitary methods.

The unit consists of an 1100-gallon steel tank served by a new Gorman-Rupp self-priming, centrifugal, sewage pump and driven by a 20-horsepower, 4-cylinder, Wisconsin air-cooled gasoline engine. The entire unit mounts on any standard truck chassis of 158 to 161 inches in length. The OSC operator simply backs his truck near the open septic tank. The fluid in the septic tank is drawn into the pump and jetted back into the septic tank until all solids are held in suspension. Then by turning a valve the contents of the septic tank are quickly pumped into the truck tank.



Century-old machine made clay pipe. Left to right, P. W. Maetzel, city engineer, Columbus, O., Orris Bonney, deputy city engineer, and Helen Gerhart, secretary.

Operators using test models in the field report 500-gallon septic tanks cleaned regularly in 15 minutes and 1000-gallon tanks in 20 minutes. At the Richland County, Ohio, home a 25,-000-gallon septic tank was cleaned thoroughly in 10 hours-a job that formerly required two weeks.

The OSC unit has many other uses,"



New odorless septic tank cleaner.

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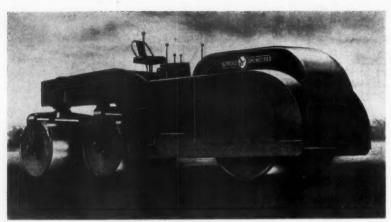
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Buffalo-Springfield 3-axle tandem roller.

Mr. Gorman said. "It can be used for street flushing, race track sprinkling, emergency fire fighting, dewatering flooded basements, or hauling water for concrete construction work."

An interesting point was made by Mr. Gorman. He said, "The OSC unit is a packaged enterprise—a complete business ready to go to work. We think it will assist young men, especially veterans, to start their own business. Actually, a veteran, by utilizing his G.I. loan rights and payment plan, can buy a new truck, equip it with an OSC unit and be in business without having any substantial initial capital."

In presenting this unit to distributors at the A.E.D. Convention, the Gorman-Rupp Company accepted orders for delivery in six weeks.

Scoopmobile Improvements

Mixermobile Mfrs., 6853 N. E. Halsey, Portland 16, Oregon, have added improvements to the standard Scoopmobile, which is a tricycle type of machine designed to handle virtually any type of materials. Power steering, using a Vickers hydraulic system has been added, as well as a fully-enclosed cab. Complete information on request. (Add to Chapter 1, Highway Manual.)



Improved Scoopmobile.

Buffalo-Springfield 3-Axle Tandem

The Buffalo-Springfield Roller Co., Springfield, O., have announced a new 3-axle tandem roller, the KX-25. This new model was designed to incorporate in one roller all the important features needed to meet present requirements for compaction equipment. In keeping with the demands for heavier machines the KX-25 will have an approximate metal weight of 12 tons and a ballasted weight of 18 tons. The wheel base will be shortened to give added maneuverability, while the rolls will be widened to give increased rolling width. All the latest improvements found in the KT model tandems will be incorporated in this new 3-axle machine. A limited number of the new model, which will be the only 3-axle model produced by Buffalo-Springfield in 1947, will be on the market in time for the current paving season.

International Powdered Payloader on Atlanta Streets

MacDougald-Warren, Inc., street and road constructors, have used their Hough "Payloader" on road contracts and miscellaneous material handling at their asphalt plant on the outskirts of Atlanta, Georgia. They have used it in grading streets, moving top dirt, and in piling and batching materials. This Payloader is powered by an International U-9 power unit (55 h.p. at 1500 r.p.m.) and is equipped with a 1-yard front-end shovel.



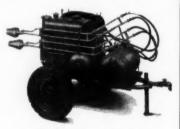
Hough Payloader handling aggregate.

A One-Man Horizontal Earth Boring Tool

Hydrauger Corp., Ltd., 116 New Montgomery St., San Francisco, Calif., has developed a new horizontal earth boring tool which can be operated by one man. It is claimed to be able to bore a straight 2-inch hole up to 50 ft., and the hole can be reamed to 3½ or 4½ ins. Boring bar sections are 2 ft. long. Especially designed for installing pipe under pavements, buildings, etc. (Add to Chapter 4, Water Works Manual.)

Weed and Insect Control

The Aeroil-Schramm Power Burner has been developed for large scale weed eradication and cooperative insect control. Each portable, self contained unit consists of engine driven compressor, fuel tank and two burners; 4, 8 or 12 gal. torch heads may be employed. Con-



Aeroil-Schramm power burner.

trol of air and fuel values regulates intensity of flame. Full description in illustrated bulletin from Aeroil Products Co., 5701 Park Ave., West New York, N. J.

Indirectly Heated, Thermostatically Controlled Kettle

Aeroil Products Co., Park Ave. & 57th St., West New York, N. J., has developed a kettle for heating and melting the new rubberized asphalt joint sealing compounds. Heating is indirect and thermostatically controlled. Bulletin 310, with "on-the-job" photographs and X-ray diagrams, describing this new unit fully, will be sent on request. (Add to Chapter 6, Highway Manual.)

Mechanical Joint Split Sleeves

James B. Clow & Sons, 201 Talman Ave., Chicago, Ill., furnish split sleeves for quickly repairing breaks in water mains. No jute or lead is required; a workman with a box or ratchet wrench



Clow split sleeve joint.

May, 1947 I Earth

116 New sco, Calif., ontal earth perated by ble to bore 50 ft., and 1/2 or 41/2 2 ft. long. alling pipe etc. (Add Manual.)

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ver Burner scale weed insect contained unit compressor. 4, 8 or 12 loyed. Con-



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rk Ave. & N. J., has g and meltsphalt joint is indirect ed. Bulletin ographs and this new quest. (Add nual.)

Sleeves

201 Talman split sleeves ks in water required; a chet wrench



can use these units regardless of trench or weather conditions. Descriptive booklet on request. (Add to Chapter 10, Water Works Manual)

Ottawa Industrial Type Front **End Loaders**

Ottawa Steel Products, Inc., Ottawa, Kans., make a front end loader for attachment to wheel tractors. These are designed for handling earth, sand, gravel, snow and other bulk materials. Material buckets are 1/2-yard; snow buckets %-yard. Scraper, and stubby bulldozer blades are attachable; also long and short booms for 16-ft. and 24-ft. lifts. This unit will dig, and will lift over 9 ft. Complete folder sent on request. (Add to Chapter 1, Highway Manual.)



Caterpillar No. 12 motor grader.



Ottawa front end loader.

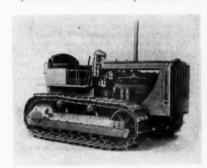
Anti-Corrosive Process

Zincilate, an anti-corrosive process which is said to afford 20 years protection to ferrous metals against all common corrosive forces has been recently announced. This "one coat" protective coating has been used successfully on pipelines and on the interiors and exteriors of water tanks and bridges. It is resistant to abrasion and gives protection through cathodic sacrifice of the film even when sizable areas are destroyed by unusual scraping or wear.

Zincilate is a product of Industrial Metal Protectives, Inc., Dayton, Ohio.

Caterpillar Graders and Tractors

New diesel No. 12 and No. 112 motor graders, and D4 and D6 tracktype tractors are announced by Caterpillar Tractor Co., Peoria, Ill. The No. 12 is 100 hp., the 112 is 70 hp. The new D4 tractor develops 43 drawbar hp and the new D6 is 65 drawbar hp. Both the graders and the tractors are powered by new diesel engines, the 4cylinder D315 and the 6-cylinder D318.



New Caterpillar D6.



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Four Booklets by Simplex

Simplex Valve & Meter Co., 68th & Upland Sts., Philadelphia, Pa., has issued four new booklets: Insert Venturi Tubes and Nozzles, showing construction and installation details for measuring flow rate of water, oil and industrial liquids; Air Inlet Valves, with complete data, accurate nomographs and concise details of design and operation; Air Release Valves, describing operation, construction and essential requirements; and Parabolic Flumes, with data on their calibration, construction, installation and capacity.

Two Bulletins by Stonhard

Stonhard Co., 833 Terminal Commerce Bldg., Philadelphia 8, Pa., has issued two new construction bulletins. The Construction Booklet contains useful information on constructing foundations and basements, laying floor surfaces, surfacing interior and exterior walls, and protecting exposed structural members; Roof Maintenance explains how to stop leaks, renew dried-out roof surfaces, and repair flashings and gutters; it also shows typical problems and their solutions.

Dorr Digesters

"Dorr Digesters, Single-Stage Multdigestion," is a 58 page, two-color treatise not only on the various types of Dorr Digesters but also on the history, theory and practice of the art of digesting sewage sludges under controlled chemical, physical and thermal conditions. The history is traced from the early work at Birmingham, England, and Baltimore, Md. in 1912 up

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to the present; basic theory and practical factors are discussed; and operational difficulties are explained with recommended solutions. A section is devoted exclusively to calculations of sizes, heat losses and heating requirements with typical examples in each case. Operating data from two dozen plants are given in tabular form, plus a list of installations of various types at cities covering a broad range in population. The portion dealing with the various types of Dorr Digesters is unusually complete. Each of the eight different types is covered with a complete description, photograph, general plan and elevation drawings and a complete set of specifications. General engineering information, presented in chart form, covers such factors as the effect of temperature on the time of digestion; the effect of rapid stirring on gas production per pound of volatile matter



IHC tractor, with bulldozer opening new streets in Florida.

destroyed; the effect of period of digestion on percentage reduction in volatile matter; the effect of period of digestion on percent solids content of sludge; and the relation between solids remaining after digestion and ash in sludges. Add to Chap. 5, Sewerage Manual.





Klemp welded steel grating on a sewage treatment plant.

Liquid Conditioning Equipment

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The most modern methods and equipment for water treatment, purification of process liquids and recovery of valuable materials from waste liquors are described in a condensed booklet issued by Liquid Conditioning Corp., 114 East Price St., Linden, N. J.

Asphalt Pavements for Parking Areas.-Details of design, maintenance and construction of asphalt parking areas are contained in a booklet by The Asphalt Institute, 801 2nd Ave., N. Y. Typical sections are illustrated. Construction specifications are covered by Cru steps, and corresponding items listed in Sol a sample bidding and contract form.

Filters.—Filters of various types an described in two new bulletins. Bulletin stan described in two new bulletins. Bulletin and lateral describes many types of clarifying filters and Bulletin 3 covers oil removal filters. In addition, Bulletin 1 explains and the design and applications of chemical stru feeders and sludge contact reactors for coagulating and removing suspended imp impurities which occur in raw water in Cur too great amount to be removed by direct filtration. Copies from Liquid Con- Port ditioning Corporation, 423 West 126 Last St., New York 27, N. Y.

Reinforcing Rubber. — A 32-page Har booklet describing a new reinforcing Gra pigment for natural or synthetic rub ber, and suggesting its use in man Grad ber, and suggesting its use in man fields, including corrosion inhibiting water treatment, as a wetting agent iron removal, etc. Industrial Chemica Sales Division 230 Park Ave., New York 17, N. Y. York 17, N. Y.

Moto-Mixers. — A 20-page bookle Suv shows the details of construction, with on-the-job photographs, and specifica ham tions. Ask for Bulletin 46-8, Chair as per Belt Co., 1600 West Bruce St., Mil Co., waukee 4, Wisc.

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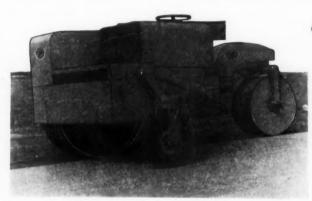
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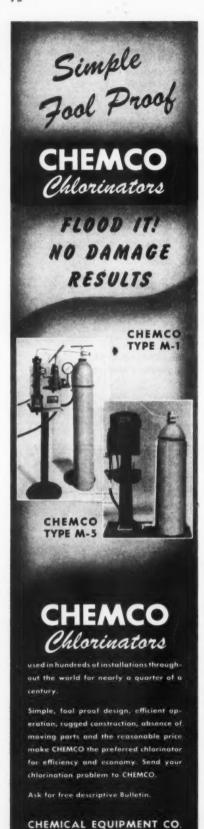
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. . Using Stonhard Roof Resurfacer is a simple matter, but it may save you thousands of dollars.

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Building Maintenance Materials

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chines will not go. Mows clean and fast in tight corners...3-foot cut and variable speed sickle bar...so well balanced a boy can run it...rugged design. Engine detachable for use on other tools or jobs.

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TECHNICAL MEETINGS

The Central States Sewage Works Association will meet in Duluth, Minn., June 20 and 21, with headquarters at the Spalding Hotel. P. W. Reed, Indiana State Board of Health, Indianapolis, Ind., is secretary.

The Pennsylvania Water Works Operators' Association will meet at State College, Pa., August 27-29. I. M. Glace, Harrisburg, Pa., is secretary. The Pennsylvania Sewage Works Operators' Association will meet at the same place the first part of the same week.

The New York State Sewage Works Association and the New England Sewage Works Association will hold a joint meeting at the Ten Eyck Hotel, Albany, N. Y., on May 26 and 27. Walter E. Merrill, 511a State House, Boston, Mass., is secretary of the New England Association and A. F. Dappert, State Department of Health, Albany, N. Y., of the N. Y. Ass'n.

JOBS FOR ENGINEERS

The Bureau of Reclamation needs engineers. Generally service will be in the midwest or west. Pay is \$3397 to \$4902. A degree or four years of training and experience, plus 1 to 3 years of responsible professional experience, are required. Rating will be on applications, which must be filed not later than May 20 with the Executive Secretary, Civil Service Examiners, Room 230, New Customhouse, Denver 2, Colo. Applications (forms 14 and 57 and card form 5001-ABC) can be obtained from 1st and 2nd class post-offices or any regional Civil Service Office.

Top Notch Engineer Available

Sanitary engineer 37; state health experience; nearly five years in Sanitary Corps; released as Lt. Col.; demonstrated high ability as administrator and manager; just returned from foreign duty with civilian organization for which he was in responsible charge; available after May 1; prefers work in this country. Write Col. Hardenbergh, this magazine, who recommends him highly.

WANTED TO PURCHASE

Sealed proposals for furnishing to the City of Port Jervis, one augur type snow loader mounted on four wheel drive truck and one mechanical street sweeper, will be received by the Common Council of said City at the City Hall, No. 21 Sussex Street, in said City, up to 8 P.M. on Tuesday, May 20, 1947, in accordance with specifications on file in the office of the City Engineer, Franklin Street, Port Jervis, N. Y.

Dated, Port Jervis, N. Y., April 21, 1947.
William C. Marchant, City Clerk.

FOR SALE

60,000 Gallon Water Tank—condition as is where is—located in Wayne, Michigan. For further information, address the Board of Wayne County Road Commissioners, 3800 Barlum Tower, Detroit 26, Michigan.

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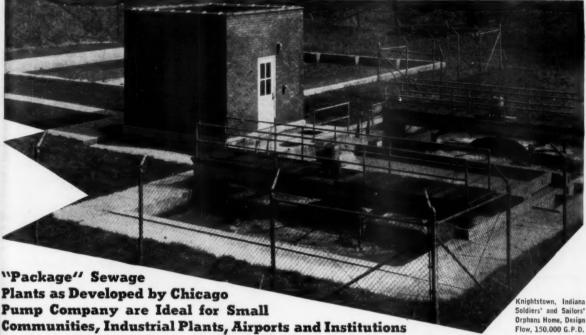
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They require a minimum of operating supervision, produce a sparkling clear effluent, are free from flies, foul odors and unsightly appearance. Can be located near dwellings.

Initial cost of "Package" plants is low and they are inexpensive to operate.

Local Operators without previous sewage treatment experience successfully operate these plants. Former farmers, salesmen, coal-miners, truckdrivers are operating existing plants and performing other municipal duties.

Operator training service by Chicago Operating Sanitary Engineers is provided with each plant. Ingenious automatic features of Chicago "Package" plants simplify operation and assure successful performance.

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THE MIDGET

Smallest of more than 50 models of Gorman-Rupp centrifugal pumps, the

Smallest of more than 50 models of Gorman-Rupp centrifugal pumps, the Midget can do hundreds of handy pumping jobs. Small, compact—weighs only 60 pounds complete—easily handled by one man. Automatic self-primed—when the motor starts, the water starts. Streamlined interior can't clog. Pumps more water for its size than any other pump on the market.

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Gorman-Rupp Model 1602 (90M) pump. capacity 1,500 GPM at average total head.

HERE'S A GOOD BUSINESS FOR SOMEONE IN YOUR TOWN!

Public Health Officials -Show this Announcement to Sanitary Service Operators in Your Community!

The New Odorless Sanitary Cleaner is modern apparatus for cleaning septic tanks, vaults and cisterns. It is complete in every respect. It is shipped ready to mount on standard truck chassis, 158 to 161 inches length. It is built by the Gorman-Rupp Company, a leader in the pump industry.

This O. S. C. unit is approved by public health officials because it eliminates old-style, makeshift equipment—often open tanks, diaphragm hand pumps and even shovels. With an O. S. C., cleaning the septic tank is as casual and efficient as any other household service.

The O.S.C. has a powerful Gorman-Rupp Centrifugal Sewage Pump of self-priming design. Septic tanks of 500 gallon size are cleaned in 15 minutes; 1,000 gallon size in 20 minutes. A 25,000 gallon septic tank was cleaned in just 10 hours.

It's water-tight, fly-proof and entirely enclosed. A boon to operators now in business. A real opportunity for the veteran wanting his own business. Buy an O. S. C. unit under the G. I. Bill of Rights.

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